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THE TREATMENT OF OCULAR TUBERCULOSIS WITH TUBERCULIN *

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The successful use of tuberculin in the treatment for ocular tuberculosis has been challenged by a number of internists as well as by ophthalmologists. There is undoubtedly some justification for this skepticism, as it is unanimously agreed that tuberculin, if improperly given, can do far more harm to the eye than good. For a number of years I have been interested in the treatment for this disease, and the results of the treatment of a selected group of patients have been so gratifying that their publication might be instructive.

During the last quarter of a century the attitude of ophthalmologists toward obscure ocular lesions has changed to a great degree. Vague terms, such as rheumatic eye disease and so-called idiopathic disease of the sclera, have been properly discarded because of the newer knowledge of disease. Verhoeff [1] went so far as to say that "ordinary scleritis and keratitis, that is to say, anterior nodular scleritis, are always due to tuberculosis." Wilmer [2] analyzed a group of cases of uveal inflammation and found that tuberculosis was the cause in 40 per cent. In a group of cases of chorioretinitis, tuberculosis was the cause in 42 per cent, and in a group of cases of choroiditis it was the cause in 44 per cent. The disease, therefore, is recognized as a distinct entity, but considerable difference of opinion exists relative to the merits of treatment with tuberculin.

In a recent publication by Wilmer,[2] an excellent summary of the clinical observations in ocular tuberculosis was presented. The following brief abstract of his classification should clarify the disease for those who are unfamiliar with it:

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* Submitted for publication, Dec. 20, 1929.

* From the Wilmer Institute of the Johns Hopkins Hospital.

1. Verhoeff, F. H., in discussion on Benedict, W. L.: Pelvic Organs as Foci of Infection in Inflammatory Diseases of the Eye, Tr. Am. Ophth. Soc., 1926, vol. 26.

2. Wilmer, W. H.: Clinical Aspect of Ocular Tuberculosis, Arch. Ophth. **57**:1, 1928.

There are three types of tuberculous intra-ocular inflammations that I wish to speak of. The first is uveitis, with varying intra-ocular tension; mutton fat deposits upon the posterior surface of the cornea with or without posterior synechiae; in the more severe cases, exudation upon the anterior capsule of the lens; vitreous opacities; often in the macular region circumscribed or disseminated chorioretinitis. In this kind of uveal inflammation there may be no other recognizable tuberculous focus. But in some cases it is associated with tuberculous foci in other parts of the body. . . . In the second group of cases the lesion is confined mostly to the posterior segment of the uveal tract; the cornea and iris are not visibly involved; the vitreous is free from opacities, or, at most, they are fine and dustlike; but the local inflammation makes up in severity for the escape of the anterior portion of the eye. There is usually a large yellowish-white exudate at the site of the older spots of inflammation, the oldest spots being slightly pigmented; this exudate itself is surrounded by retinal hemorrhages. This appearance is the result of hyperemia, edema, cellular infiltration, rupture of the fine blood vessels, and the formation of fibrous tissue. In the eye first involved, whose vision is usually seriously impaired, there is a white fibrous mass, with no signs of active inflammation or recent hemorrhages. This illustrates nature's attempt to shut off the bacilli and their toxins by a fibrous tissue, but too late to save the eye. This is the kind of eye in which a large dose of tuberculin for diagnosis or for cure would be disastrous. . . . The third type of cases is of great human interest—youthful subjects with recurrent hemorrhages into the vitreous. . . . In these patients where the vision of one eye was severely impaired, the loss of sight was due to very extensive and repeated hemorrhages, with the subsequent formation of fibrous tissue, retinitis proliferans.

A most complete review of the literature was given by Wilmer [2] and more recently by King.[3] According to Clapp,[4] tuberculosis of the eye was described as early as 1818, and in 1855 von Graefe,[5] reporting a case of tuberculous choroiditis in swine, suggested that choroidal exudates in children might be tuberculous. A number of authors have reviewed the clinical course of ocular tuberculosis and the results of tuberculin treatment. Von Hippel,[6] Bernheimer,[7] Meller,[8] Novak [9] and Woods in collaboration with Rones [10] enthusiastically supported the use

3. King, C.: The Therapeutic Value of Tuberculin in Ophthalmology, Arch. Ophth. **1**:713 (June) 1929.

4. Clapp, C. A.: Tuberculosis of the Eye and Its Treatment, Am. Rev. Tuberc. **7**:81, 1923.

5. Von Graefe, A.: Präparat von Choroiditis tuberculosa bei einem Schweine, Arch. f. Ophth. **2**:213, 1855.

6. Von Hippel, H.: Ergebnisse der Tuberculinbehandlung bei der Tuberculose des Auges, Arch. f. Ophth. **87**:193, 1914.

7. Bernheimer, S.: Tuberculinbehandlung Augenkranker, Klin. Monatsbl. f. Augenh. **16**:579, 1913.

8. Meller, J.: Ueber die Behandlung von Augenkrankheiten mit Tuberkulin, Wien. klin. Wchnschr. **35**:193, 1922.

9. Novak, E.: Die specifische Behandlung der Augentuberkulose durch den praktischen Artzt, Wien. klin. Wchnschr. **35**:764, 1922.

10. Woods, A. C., and Rones, B.: The Therapeutic Use of Tuberculin in Ocular Tuberculosis, South. M. J. **21**:613 (Aug.) 1928.

of tuberculin. Pessimistic reports have been made by Gilbert [11] and Hess [12] and more recently by Derby and Carvill.[13] These authorities credited the results obtained with tuberculin therapy entirely to good hygiene and psychotherapy.

The purpose of this paper is to present in a clinical report the methods of diagnosis and treatment used in the Wilmer Clinic of the Johns Hopkins Hospital and to report the results of such treatment in a selected group of thirty patients who were referred to the clinic. This group is noteworthy because with two exceptions each patient had been examined and treated in various other clinics; in the majority of patients, a complete medical survey had been made before admission to the Wilmer Clinic; all discoverable foci of infection had been eliminated months, in some instances years, before the patients came under observation, and the majority of the patients had been given the discouraging advice that nothing further could be done. Incidentally, they had been treated by both proponents and opponents of tuberculin therapy, and in several instances tuberculin had been tried in a haphazard way to relieve the condition, without results.

In this group of patients, fifteen suffered from choroiditis, chorioretinitis and uveitis; eight from keratitis; one from a tuberculous nodular scleritis; one from iritis, and five from recurrent intra-ocular hemorrhages. The use of tuberculin in any of these types is indicated if sensitiveness to tuberculin is established, and if improved hygiene and removal of infection fail to bring about improvement. In the cases presented in this report the patients were carefully surveyed before tuberculin therapy was considered. As mentioned, they form an interesting group because with one or two exceptions no focus of infection was found, nor was there any concurrent disease which might explain the cause. Derby and Carvill [13] mentioned that improvement in hygiene is perhaps the most important adjunct in the treatment for this type of ocular disease. Many of these patients had lived under the most ideal conditions and no alteration was made during the course of treatment. Others, particularly the colored group, lived under anything but hygienic circumstances. The environment and mode of living purposely was not changed in this group, and yet the results with tuberculin were most gratifying.

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11. Gilbert, W.: Erkrankung des Uvealtraktus, Handbuch der gesamten Augenheilkunde, ed. 2, Axenfeld and Elschnig, vol. 5, p. 6.

12. Hess, in Lowenstein: Die Tuberculose des Auges, Berlin, Urban & Schwarzenberg, 1924.

13. Derby, J. S., and Carvill, M.: Anterior Ocular Tuberculosis, Proc. Am. Ophth. Soc., 1927.

METHOD OF DIAGNOSIS

The method of diagnosis is by no means new. The patients in this group were tested by the intradermal technic, the original tuberculin (old tuberculin) of Koch being used. This tuberculin was prepared in the Henry Phipps Tuberculosis Laboratory of the Johns Hopkins Hospital (Willis [14]). It is standardized as equivalent to 1,000 mg. of tuberculin to 1 cc. The concentrated tuberculin was diluted, so that the stock solution used in testing contained the amount of tuberculin indicated in table 1.

With these dilutions, the sensitivity of the patients is determined. It is necessary to use a control solution in order to rule out possible reactions to the medium. One-tenth cubic centimeter of a 1 : 1,000 dilution of the control medium is injected intradermally under sterile precautions at a site on the forearm near the wrist. A tuberculin syringe is used. At the same time, 0.1 cc. of the 1:100,000 dilution of old tuberculin is injected about 3 inches (7.6 cm.) above the control on the same arm. The actual amount of tuberculin injected is 0.001

TABLE 1.—*Dilutions of Tuberculin Used in Diagnosis*

0.1 cc. 1:10 dilution	10 mg.
0.1 cc. 1:100 dilution	1 mg.
0.1 cc. 1:1,000 dilution	0.1 mg.
0.1 cc. 1:10,000 dilution	0.01 mg.
0.1 cc. 1:100,000 dilution	0.001 mg.

Control solution: 1:1,000 dilution of glycerin = broth medium without tuberculin.

mg. If there is no reaction after forty-eight hours, a second injection is given, consisting of 0.1 cc. of a 1:10,000 dilution (0.01 mg.) of tuberculin. If the patient fails to react to this dilution after forty-eight hours, further injections are given until it is definitely established that the patient will not react to a full milligram of tuberculin. In my experience, it has been unusual to find a skin which reacts to the control solution.

INTERPRETATION OF REACTIONS

A positive reaction consists of infiltration and hyperemia about the site of injection. It appears in from six to eight hours, reaches its maximum in between twenty-four and forty-eight hours and disappears in from five days to six months. The simplest method of recording the results is to measure the width of the infiltration and the hyperemia after forty-eight hours.

Conservative appraisal of skin reactions is most essential. Just as in the study of a patient with hay-fever or asthma, so in ocular tuberculosis

14. Willis, H. S.: Laboratory Diagnosis and Experimental Methods in Tuberculosis, Springfield, Ill., Charles C. Thomas.

the result of intradermal tests is occasionally confusing. Hamman and Wolman [15] said: "If it is found that the patient reacts markedly to intradermal injections of extremely minute doses of tuberculin, the presumption that there is some activity in the tuberculous infection of the patient is strengthened and with some reservations we may feel a greater certainty that the ocular trouble is of tuberculous origin."

On the other hand one must not overlook the fact that certain patients who have clinical tuberculosis give negative skin reactions. In a most thorough study of the pathogenesis of human tuberculosis, Rich and McCordock [16] made the following statement:

> We have ample evidence that allergy, as tested by the skin reaction to tuberculin, may diminish during active infection to the point that relatively enormous doses of tuberculin fail to produce any more reaction than in normals, and Baldwin, Krause, Willis, Calmette and others have observed marked waning of allergy in animals made resistant by inoculation with bacilli of low virulence. . . . Whether allergy, once established, is ever completely lost we cannot say. It is said by some that if large enough doses of tuberculin are given, some sort of allergic response can be obtained in every individual who has once been allergic.

This must be mentioned because in several of the cases of tuberculous disease reported herewith, the patients required a much larger dose of tuberculin to produce an allergic reaction than is necessary in the majority of instances.

Routinely, the interpretation of intradermal reaction is as follows: A violent reaction to 0.001 mg. of tuberculin is definite evidence of active tuberculosis somewhere in the body. The diagnosis of ocular tuberculosis is made on the clinical appearance of the eye, the absence of other etiologic factors and the presence of the indicative tuberculin reaction. If the patient gives a negative reaction to 0.001 mg., the evidence is a trifle less certain; but such a reaction is presumptive evidence of an active tuberculosis. If the patient fails to react to 0.01 mg. but shows positive reaction to 0.1 mg., the tuberculin is of little value as a diagnostic aid. However, a parallel with patients suffering from hayfever can be drawn. The degree of sensitiveness, as already mentioned, does not necessarily indicate the severity of the ocular disease. Nor does the violent reaction to a minute dose (0.001 mg.) indicate a bad prognosis for the diseased eye. It must be admitted, however, that in the average patient greater significance is attached to a reaction from the weak dilutions (0.001 and 0.01 mg.) than to a reaction from the strong dilutions (0.1 and 1 mg.).

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15. Hamman and Wolman: Tuberculosis in Diagnosis and Treatment, New York, D. Appleton & Company, 1912.

16. Rich, A. R., and McCordock, N. A.: An Inquiry Concerning the Rôle of Allergy, Immunity and Other Factors of Importance in the Pathogensis of Human Tuberculosis, Bull. Johns Hopkins Hosp. **44**:273, 1929.

The method of diagnosis and the interpretation of reactions in the study of ocular tuberculosis in the Wilmer Institute differ considerably from similar procedures in the hands of other workers. Török,[17] for example, who in 1919 reported his experience with tuberculin, used massive doses for diagnosis, giving intradermally from 1 to 5 mg. He tried to produce a focal reaction in the eye before he considered the lesion tuberculous. Several investigators use similar methods of diagnosis. This is a drastic procedure, and such massive dosage is quite needless. Furthermore, the danger of destroying a diseased eye by this method is obvious.

METHOD OF TREATMENT

The method of treatment used in ocular tuberculosis depends on the attitude of the physician. If a nonspecific form of treatment is desired, the method that I have used is wrong. By nonspecific treatment it is understood that a violent constitutional as well as a focal reaction is produced, whether it is in the eye diseased by tuberculosis or in the joints of a person with arthritis. The result of such a method applied in the treatment for ocular tuberculosis has often been so disastrous that enucleation of the diseased eye has been necessary.

The treatment of these patients is based on the experience of investigators who have practiced the method for years. The treatment is given in an empiric but safe manner in doses of extremely small concentration. Bouillon filtrate (B. F.) is used, prepared according to the technic of Denys,[18] who described this preparation in 1905.

The bouillon filtrate of Denys is a stable material one-tenth as strong as the diagnostic preparation of old tuberculin. Many workers prefer a bacillus emulsion. It is my opinion that the emulsion is responsible for many failures, as well as for severe focal reactions. If an emulsion of tubercle bacilli contains, for example, a million minute particles in 0.1 cc., it is impossible to dilute the material accurately when one deals with a dilution as high as one part in 10,000,000. In other words, one dilution may contain 999 particles when it should contain only 9 particles. This inaccuracy cannot occur when one is diluting a filtrate. The bouillon filtrate has therefore been routinely used in the treatment of these patients.

The initial dose in most cases is 0.000001 mg. of tuberculin injected into the deltoid muscle. The concentration is gradually increased over a period of from six to ten months, depending on the tolerance of the patient, until a maximum dose of 100 mg. is given.

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17. Török, E.: Tuberculin in the Diagnosis and Treatment of Eye Diseases, Arch. Ophth. **48**:242, 1919.

18. Denys: Le boüillon filtré, Paris, 1925.

The treatment is given twice each week until a concentration of 1 mg. per cubic centimeter is reached, at which time it is given once each week. By this method, nearly a year is required to complete the treatment. In some instances a longer time is necessary, depending on the behavior of the eye. Careful and frequent observation of the eye by an ophthalmologist is one of the most important features of the method. A focal reaction is a warning that harm is resulting from a too rapidly increased dosage of tuberculin. Under such circumstances, the subsequent doses of tuberculin should be reduced to a level of safety. After a dose of 100 mg. has been reached, it is advisable to continue this dose at weekly intervals for a period of months in order that recurrences may be aborted.

For practical purposes a series of dilutions is used, each serial being one-tenth the volume strength of the former. Number 1, for example contains pure tuberculin; number 2, 9 cc. of diluent and 1 cc. of tuberculin; number 3, 9 cc. of diluent and 1 cc. of number 2, and so on. The diluent is 0.8 per cent salt solution (chemically pure sodium chloride) with 0.25 per cent of phenol. Fresh solutions should be prepared at least once each month (table 2).

From experience with this method, which has been used in the Wilmer Clinic, observations of the results obtained indicate that the healing of the lesions is not due to a nonspecific reaction but is brought about by some immunologic process which alters the diseased tissue cells. It is a well known fact that by administering repeated doses of tuberculin to the allergic human being tolerance, or a so-called desensitized state to tuberculin, may be brought about, to the extent that enormous doses, which otherwise might produce constitutional symptoms and local necrosis, can be tolerated with impunity.

Theoretically, the object of the treatment is not to start with any given dose or to increase dosage at any definite rate, but to give as much as the patient can tolerate without visible reaction. It is impossible to answer specifically the question what dose a patient can tolerate, when the susceptibility to tuberculin is an unknown quantity. Therefore, the initial dose should be so small that no harm will be done by it. Doubtless in many instances, the initial amount given to these patients has been smaller than need be; but no harmful effects have occurred in a single instance in consequence of the caution exercised. Furthermore, one must not overlook the immunologic features of the method of treatment. Healing of the lesion is brought about not by the volume of material administered, but rather by the potency and quality of the tuberculin. Many students of ophthalmology overlook the wide gap between immunologic processes and chemical reactions. They must realize the potency of infinitely small doses of antigens or their effort in treating ocular tuberculosis with tuberculin will meet with failure.

As pointed out by Rich and McCordock,[16] it is the generally accepted view that the beneficial result obtained from injections of tuberculin is a mild inflammation produced at the focus of tuberculous infection, and that this inflammation stimulates healing by the production of fibrosis in the lesion. In ocular tuberculosis such inflammation has not been

TABLE 2.—*Instruction for Tuberculin Treatment* *

Injection Should be Given Every Tuesday and Friday		Begin Treatment Once Each Week	
Solution 9 (1/100,000 of a mg. per cc.)		**Solution 4 (1 mg. per cc.)**	
Dose 1	0.1 cc.	Dose 37	0.1 cc.
Dose 2	0.2 cc.	Dose 38	0.2 cc.
Dose 3	0.35 cc.	Dose 39	0.3 cc.
Dose 4	0.5 cc.	Dose 40	0.4 cc.
Dose 5	0.7 cc.	Dose 41	0.5 cc.
Dose 6	0.9 cc.	Dose 42	0.6 cc.
		Dose 43	0.7 cc.
Solution 8 (1/10,000 of a mg. per cc.)		Dose 44	0.8 cc.
Dose 7	0.1 cc.	Dose 45	0.9 cc.
Dose 8	0.2 cc.		
Dose 9	0.35 cc.		
Dose 10	0.5 cc.		
Dose 11	0.7 cc.		
Dose 12	0.9 cc.		
		Solution 3 (10 mg. per cc.)	
Solution 7 (1/1000 of a mg. per cc.)		Dose 46	0.1 cc.
Dose 13	0.1 cc.	Dose 47	0.2 cc.
Dose 14	0.2 cc.	Dose 48	0.3 cc.
Dose 15	0.35 cc.	Dose 49	0.4 cc.
Dose 16	0.5 cc.	Dose 50	0.5 cc.
Dose 17	0.7 cc.	Dose 51	0.6 cc.
Dose 18	0.9 cc.	Dose 52	0.7 cc.
		Dose 53	0.8 cc.
Solution 6 (1/100 of a mg. per cc.)		Dose 54	0.9 cc.
Dose 19	0.1 cc.		
Dose 20	0.2 cc.		
Dose 21	0.3 cc.		
Dose 22	0.4 cc.		
Dose 23	0.5 cc.		
Dose 24	0.6 cc.		
Dose 25	0.7 cc.		
Dose 26	0.8 cc.		
Dose 27	0.9 cc.		
		Solution 2 (100 mg. per cc.)	
Solution 5 (1/10 of a mg. per cc.)		Dose 55	0.1 cc.
Dose 28	0.1 cc.	Dose 56	0.2 cc.
Dose 29	0.2 cc.	Dose 57	0.3 cc.
Dose 30	0.3 cc.	Dose 58	0.4 cc.
Dose 31	0.4 cc.	Dose 59	0.5 cc.
Dose 32	0.5 cc.	Dose 60	0.6 cc.
Dose 33	0.6 cc.	Dose 61	0.7 cc.
Dose 34	0.7 cc.	Dose 62	0.8 cc.
Dose 35	0.8 cc.	Dose 63	0.9 cc.
Dose 36	0.9 cc.		

* The treatment should be given with a tuberculin syringe, subcutaneously in the deltoid muscle.

observed according to Wilmer,[19] Woods,[19] Clapp[19] and others, who have made repeated ophthalmologic studies of numerous patients undergoing tuberculin therapy. The manner of healing is still a disputed question. The absence of visible focal reaction does not necessarily mean that repeated stimulation of the tuberculous lesion does not occur.

19. Personal communication to the author.

TABLE 3.—*Choroiditis, Chorioretinitis and Uveitis*

Case	Age	Sex*	Race	Duration of Symptoms	Vision Before Treatment		Vision After Treatment		Tuberculin Sensitivity		Tuberculin Dosage		Duration of Treatment‡	Result of Treatment	Recurrences of Ocular Disease
					Right Eye	Left Eye	Right Eye	Left Eye	Before Treatment, Mg.	After Treatment, Mg.	Minimum, Mg.	Maximum, Mg.			
1	54	♀	W	2 mo.	20/20	Hand motion and light perception	20/30	5/50	0.01	0.01	0.000001	100	14 months	Vision restored; disease arrested	In three years, none
2	24	♀	W	12 mo.	20/15	2/70	20/15	19/200	0.001	0.001	0.000001	100	17 months	Disease arrested; lesions healed	In three years, none
3	45	♂	W	3 mo.	5/200	20/20	20/100	20/20	0.1	Not done	0.000001	100	13 months	Vision improved; disease arrested	In two years, none
4†	26	♀	W	3 mo.	8/200	14/100	2/70	2/70	0.001	0.01	0.000001	100	11 months	Vision improved; disease arrested	In two years, none
5†	36	♀	W	3½ yr.	Blind	Choroiditis also 20/20	20/40	20/20	0.01	0.001	0.000001	10	16 months++	Vision restored; disease arrested	In one year, none
6†	50	♀	W	4 yr.	20/15	20/15	20/15	20/15	0.001	0.1	0.000001	100	16 months	Vision improved; disease arrested	In two years, none
7†	54	♂	W	1 yr.	Enucleated	20/200	.....	20/40	0.001	0.1	First course 0.000001	100	6 months	Vision improved	In two years, one
											Second course 0.000001	10	11 months++	Vision improved	
8†	54	♂	W	11 yr.	Blind	20/40	.....	20/70	0.001	0.001	0.000001	10	24 months	Vision unimproved; disease arrested	In two years, none
9†	18	♂	W	2 yr.	20/50	Blind	20/15	Enucleated	0.001	0.01	0.000001	100	11 months	Vision restored; disease arrested	In three years, none
10	27	♂	W	2 mo.	20/15	20/200	20/15	20/200	0.001	0.1	0.000001	100	14 months++	Vision improved; disease healing	In one year, none
11	31	♂	W	6 mo.	19/20	19/15	20/20	20/15	0.001	0.001	0.000001	100	20 months	Disease arrested	In two years, one; from treatment
12†	28	♂	W	7 mo.	20/200	20/30	20/15	20/20	0.001	0.01	0.000001	50	7 months	Vision restored; disease arrested	In three years, none
13†	38	♂	W	9 yr.	Candle 7 feet	Candle 20 feet	7/200	Hand movement 4 feet	0.01	0.01	0.000001	5	11 months++	Vision improved; disease healing, can see objects	
14†	30	♂	W	13 yr.	20/100	20/40	20/70	20/15	0.001	Not done	0.000001	1	9 months	Vision restored; disease arrested	In two years, none
15†	44	♂	W	13 yr.	20/200	Light perception	20/100	0	0.01	0.01	0.000001	100	20 months++	Vision improved; disease arrested	In 18 months, none

* In the tables, ♂ indicates male; ♀, female.
† Bilateral involvement.
‡ The double plus marks indicate that patients are still taking treatment.

TABLE 4.—*Scleritis and Keratitis*

Case	Age	Sex	Race	Duration of Symptoms	Vision Before Treatment		Vision After Treatment		Tuberculin Sensitivity		Tuberculin Dosage		Duration of Treatment‡	Result of Treatment	Recurrences of Ocular Disease
					Right Eye	Left Eye	Right Eye	Left Eye	Before Treatment, Mg.	After Treatment, Mg.	Minimum, Mg.	Maximum, Mg.			
16	52	♀	W	2 yr.	20/15	1/100	20/15	1/40	0.01	Not done	0.000001	100	16 months	Vision improved; disease arrested	In 10 months, none
17	50	♀	W	3 yr.	20/30	20/30	20/20	20/30	0.001	0.001	0.000001	1	10 months++	Disease arrested	In 10 months, none
18†	18	♀	C	2 mo.	3/200	10/100	5/200	20/100	0.001	0.01	0.000001	100	11 months++	Vision restored; disease arrested	In 1 year, none
19†	42	♀	W	6 yr.	20/20	20/20	20/20	20/20	0.001	0.001	0.000001	0.6	7 months++	Disease arrested	In 7 months, none
20	44	♀	W	3 yr.	20/20	20/50	20/20	20/20	0.01	0.01	0.000001	0.7	8 months++	Disease arrested	In 8 months, none
21†	25	♀	C	4 yr.	20/40	20/100	20/50	20/100	0.001	0.001	0.000001	8	27 months++	Vision improved; disease arrested	In 18 months, none
22	40	♂	W	1 wk.	20/15	20/70	20/20	20/30	0.001	0.01	0.000001	100	23 months++	Vision improved; disease arrested	In 18 months, none
23	37	♂	W	1 yr.	Fingers 4 inches	20/15	3/200	20/50	0.001	Not checked	0.000001	100	8 months	Disease arrested; vision improved	In 2¼ years, none
24*	35	♀	W	2 wk.	20/40	20/20	20/15	20/15	0.001	0.001	0.000001	100	9 months	Tubercle cleared up completely	In 3 years, none

† Bilateral involvement.
* Patient with tubercle in sclera.
‡ The double plus marks indicate that patients are still taking treatment.

TABLE 5.—*Iritis and Intra-Ocular Hemorrhages*

Case	Age	Sex	Race	Duration of Symptoms	Vision Before Treatment		Vision After Treatment		Tuberculin Sensitivity		Tuberculin Dosage		Duration of Treatment	Result of Treatment	Recurrences of Ocular Disease
					Right Eye	Left Eye	Right Eye	Left Eye	Before Treatment, Mg.	After Treatment, Mg.	Minimum, Mg.	Maximum, Mg.			
25	40	♂	W	4 yr.	20/40	20/16	20/20	20/16	0.001	0.001	0.000001	100	19 months	Disease arrested	In 2½ years, none
26	23	♂	W	3 mo.	1/200	20/15	1/40	20/15	0.01	0.01	0.000001	7	19 months	Vision improved; disease arrested	In 13 months, none
27†	37	♂	W	3 yr.	Blind	Blind	20/15	20/20	0.001	0.001	0.000001	100	22 months	Disease arrested; vision restored	In 3 years, none
28†	19	♂	W	8 mo.	Light perception	20/30	Enucleated	20/40	0.01	0.01	0.000001	100	3 years	Disease arrested	In 3 years, none
29†	25	♂	W	12 yr.	19/15	1/200	.....	.....	0.001	Not checked	0.000001	30	2 years	Disease arrested; vision improved	In 3 years, none
30†	32	♂	W	1 yr.	Hand motion at 8 inches	2/200	20/50	20/30	0.001	0.01	First course 0.000001	100	12 months	Vision improved	In 3 years, one; mild hemorrhage
											Second course 0.01	100	6 months	Disease arrested	

† Bilateral involvement.

In each instance the eyes of the patients in this report have been carefully studied from time to time by Dr. Wilmer or members of his staff, and focal reactions have been looked for. If such a reaction appeared, as it did in several instances, it was an indication that the dosage should be decreased at the subsequent injection. The result desired was for the disease literally to heal without any evidence of a flare-up. This is exactly what did occur in the majority of patients. The beneficial effect is due not to focal inflammatory reaction but rather to desensitization. Furthermore, healing was apparent in several instances within one month after the onset of treatment, when the dose of tuberculin was not more than 0.000007 mg., an amount infinitely too small to cause a nonspecific reaction. Likewise violent constitutional as well as focal reactions have appeared in patients undergoing treatment from an equally minute dose.

PROTOCOLS OF CASES CLINICALLY DIAGNOSED AS OCULAR TUBERCULOSIS [20]

Group 1.—Tuberculous Choroiditis, Chorioretinitis and Uveitis.

CASE 1.—N. K., a white woman, aged 54.

Diagnosis: Tuberculous uveitis with secondary glaucoma.

Onset: In December, 1926, the left eye became inflamed and vision became cloudy. In January, 1927, glaucoma developed. On Feb. 1, 1927, the patient was admitted to Wilmer Institute. Removal of the eye had been advised by several ophthalmologists.

Diagnostic Survey: Entirely negative.

Vision Before Treatment: Right eye, 20/20; left eye, hand motion and light perception.

Tuberculin Sensitivity: February, 1927, positive to 0.01 mg.

Tuberculin Therapy Begun: February, 1927; initial dose, 0.000001 mg.

Course of Disease: Improvement of vision. Objects gradually discernible. On Nov. 22, 1927, vision in the right eye was 20/30; in the left eye, 5/100. Still continued to show hypersensitivity to 0.01 mg. of tuberculin. On April 23, 1928, vision in the right eye was 20/15; in the left eye, 5/100.

Tuberculin Sensitivity After Treatment: Still positive to 0.01 mg.

Duration of Treatments: Fourteen months.

Maximum Dose of Tuberculin: 100 mg.

Result of Treatment: An eye practically blind regained fair function. Enucleation of the eye was avoided. The patient can read without difficulty. The eye on external examination is normal, having been violently inflamed and soft when first seen.

Vision After Treatment: On April 10, 1929, vision in the right eye was 20/30; in the left eye, 5/50.

CASE 2.—B. C., a white woman, aged 24.

Diagnosis: Tuberculous uveitis; chorioretinitis.

Onset: In Decemeber, 1925, there was severe pain over the left side of the head with gradual impairment of vision in the left eye. Vision in the left eye

20. In these protocols all vision tests are corrected tests.

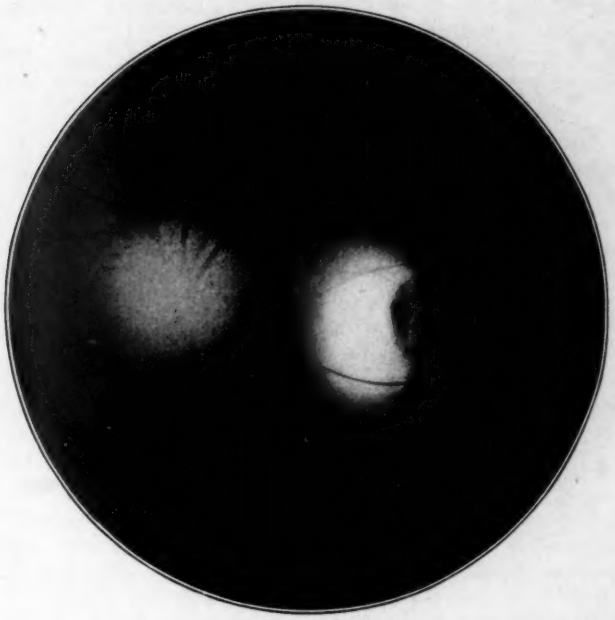

Fig. 1 (case 2).—Tuberculous chorioretinitis: appearance of fundus before treatment.

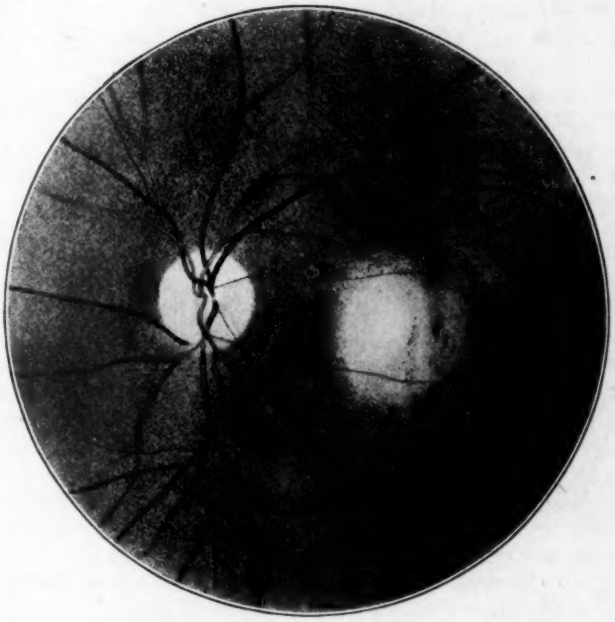

Fig. 2 (case 2).—Appearance of fundus after treatment.

was lost entirely by November, 1926. The pain subsided. In December, 1926, she was admitted to the Wilmer Institute.

Diagnostic Survey: Scars from an old chronic osteomyelitis were seen on the legs.

Vision Before Treatment: Right eye, 20/15; left eye, 2/70.

Tuberculin Sensitivity: December, 1926, positive to 0.001 mg.

Tuberculin Therapy Begun: January, 1927, initial dose, 0.000001 mg.

Course of Disease: Gradual clearing up of vision with disappearance of the lesions in the fundus. Discharged from institute on Feb. 12, 1927, with vision in the right eye, 20/15; in the left eye, 5/100. On March 24, 1927, vision in the right eye was 19/15; in the left eye, 19/200. The last dose of tuberculin was 100 mg. on Oct. 23, 1928.

Tuberculin Sensitivity After Treatment: Still positive to 0.001 mg.

Duration of Treatment: Seventeen months.

Maximum Dose of Tuberculin: 100 mg.

Result of Treatment: Lesions in fundus have cleared up. Vision is excellent.

Vision After Treatment: Able to carry on occupation as a nurse.

CASE 3.—F. D., a white man, aged 45.

Diagnosis: Uveitis, right eye; tuberculous.

Onset: About January, 1928, pain occurred under the eyelid and the patient developed redness of the right eye (iritis). The discomfort and redness had been intermittent from January, 1928, until admission to the Wilmer Institute in March, 1928.

Diagnostic Survey: Negative.

Vision Before Treatment: Right eye, 5/200; left eye, 20/20.

Tuberculin Sensitivity: March, 1928, positive to 0.1 mg.

Tuberculin Therapy Begun: March, 1928; initial dose, 0.00001 mg.

Course of Disease: Rapid improvement of the eye with clearing up of the pain and inflammatory reaction. Discharged from Wilmer Institute on April 2, 1928. Vision in the right eye, 3/40; in the left eye, 20/20. Tuberculin treatment was continued at home. On June 12, 1928, vision in the right eye was 20/70; in the left, 20/20. There were no symptoms.

Tuberculin Sensitivity After Treatment: Not determined.

Duration of Treatment: Thirteen months.

Maximum Dose of Tuberculin: 100 mg.

Result of Treatment: Marked improvement with clearing up of uveitis and improvement in vision. No recurrence.

Vision After Treatment: On June 24, 1929, vision in the right eye was 20/100; in the left eye, 20/30.

CASE 4.—M. D., a white woman, aged 26.

Diagnosis: Choroiditis, diffuse, bilateral and tuberculous, and bilateral uveitis.

Onset: In September, 1927, the vision of the right eye became impaired. About Nov. 9, 1927, vision in the left eye became impaired.

The patient was admitted to Wilmer Institute in November, 1927.

Diagnostic Survey: Negative.

Vision Before Treatment: Vision in the right eye was 8/200; in the left eye, 14/100.

Tuberculin Sensitivity: October, 1927, positive to 0.001 mg.

Tuberculin Therapy Begun: November, 1927; initial dose, 0.000001 mg.

Course of Disease: Discharged from Wilmer Institute, Nov. 25, 1927. Vision in the right eye was 9/100; in the left eye, 20/70. Treatment was continued in

the Johns Hopkins dispensary. Tuberculin sensitivity was determined in March, 1928. The reaction was negative to 0.001 mg.; positive to 0.01 mg. In June, 1928, vision in the right eye was 15/200; in the left eye, 18/200.

Tuberculin Sensitivity After Treatment: October, 1928, positive to 0.01 mg.

Duration of Treatment: Eleven months.

Maximum Dose of Tuberculin: 50 mg.

Result of Treatment: The choroiditis became quiescent. The vision was much improved. In April, 1929, the patient was able to read large letters. The vision continues to improve.

Vision After Treatment: In October, 1929, vision in the right eye was 2/70; in the left eye, 2/70.

CASE 5.—Mrs. B. S., a white woman, aged 36.

Diagnosis: Bilateral choroiditis.

Onset: The patient gave a history of having had double vision for three and a half years before consulting Dr. Friedenwald. She was seen by Dr. Friedenwald in April, 1928. Six months before seeing him she lost the vision of her right eye.

Diagnostic Survey: Chronic tonsillitis.

Vision Before Treatment: Right eye, blind; left eye, 20/20.

Tuberculin Sensitivity: April, 1928, positive to 0.01 mg.

Tuberculin Therapy Begun: August, 1928, initial dose, 0.000001 mg.

Course of Disease: At the first examination in April, the patient showed a subacute choroiditis in the macular region of the right eye. In the left eye there was a similar older patch, which fortunately was not in the macular region. The tonsils were removed. No improvement resulted. Finally in August, 1928, tuberculin treatment was instituted. In November, 1928, vision in the right eye was 20/30; in the left eye, 20/20. In August, 1929, vision in the right eye was 20/40. In April, 1929, the tuberculin reaction was positive to 0.01 mg.; negative to 0.001 mg. Treatment was continued until August, 1929, when the patient showed a violent reaction to tuberculin in spite of the fact that she was receiving 5 mg. of tuberculin with increasing doses each week.

Tuberculin Sensitivity After Treatment: The patient reacted to 0.001 mg.

Duration of Treatment: Sixteen months.

Maximum Dose of Tuberculin: 10 mg.

Result of Treatment: The choroiditis had healed, and the patient's vision was excellent on Aug. 20, 1929. She is still receiving treatment, the last dose being 10 mg. of tuberculin.

CASE 6.—L., a white woman, aged 50.

Diagnosis: Choroiditis.

Onset: The patient gave a history of impaired vision for the past four years. The patient was examined by Dr. Bagley in December, 1927.

Diagnostic Survey: Negative.

Vision Before Treatment: Right eye, 20/15; left eye, 20/15.

Tuberculin Sensitivity: December, 1927, positive to 0.001 mg.

Tuberculin Therapy Begun: December, 1927; initial dose, 0.000001 mg.

Course of Disease: The patient received a course of treatment with a rapid clearing up of the choroiditis.

Tuberculin Sensitivity After Treatment: In March, 1929, the reaction was negative to 0.001 mg. and to 0.01 mg. It was positive to 0.1 mg.

Duration of Treatment: Sixteen months.

Maximum Dose of Tuberculin: 90 mg.

Result of Treatment: Choroiditis entirely healed.

Vision After Treatment: In March, 1929, vision in the right eye was 20/15; in the left eye, 20/15.

CASE 7.—J. M. H., a white man, aged 54.

Diagnosis: Recurring uveitis, tuberculous; secondary glaucoma in left eye.

Onset: In early life the right eye had been destroyed by an accident. In August, 1925, the patient developed a burning sensation, accompanied by marked injection, in his left eye. He had recurring attacks of so-called iritis from August, 1925, to September, 1926. In September he had a number of badly decayed teeth removed, and as a result his eye became much worse. Because of failing vision, he was admitted to the Wilmer Institute.

Diagnostic Survey: Negative.

Vision Before Treatment: Right eye, enucleated; left eye, 20/200.

Tuberculin Sensitivity: December, 1926, positive to 0.001 mg.

Tuberculin Therapy Begun: December, 1926; initial dose 0.000001 mg.

Course of the Disease: The patient improved rapidly. Three months after treatment vision in the left eye had improved to 20/30. Treatment was continued until July, 1927 (six months). The patient returned to his home, and was free from all symptoms until December, 1928 (two years), when he was readmitted to the Wilmer Institute with acute glaucoma. Vision in the left eye was 1/200. Tests for tuberculin sensitivity showed a positive reaction to 0.01 mg. An emergency paracentesis was done, and in January, 1929, the patient was discharged to begin tuberculin treatment again. On Aug. 20, 1929, vision had improved from 1/200 to 20/50 +. The eye was entirely quiet.

Tuberculin Sensitivity After Treatment: In October, 1929, the reaction was positive to 0.1 mg.

Maximum Dose of Tuberculin: The present dose of tuberculin, which is still being continued, is 10 mg.

Duration of Treatment: First course, six months; second course (which is still in progress), eleven months.

Result of Treatment: Undoubtedly the remaining eye has been saved.

Vision After Treatment: 20/40.

CASE 8.—J. F. B., a white man, aged 54.

Diagnosis: Uveitis of the left eye with secondary glaucoma; diabetes mellitus.

Onset: In 1916 the patient developed an ulcer on the right cornea. It healed, however, leaving a scar and impaired vision. The ulceration recurred frequently on the cornea of both eyes between the years of 1916 and 1917, finally destroying the vision in the right eye. The diabetes was constantly held under control with insulin. A general impression that the condition of the eye was due to syphilis suggested repeated courses of antisyphilitic therapy without improvement. He was finally admitted to the Wilmer Institute in July, 1927.

Diagnostic Survery: The patient had been treated in the Johns Hopkins dispensary for diabetes mellitus for years.

Vision Before Treatment: Right eye, no light perception; left eye, 20/40.

Tuberculin Sensitivity: In December, 1928, positive to 0.001 mg.

Tuberculin Therapy Begun: January, 1928; initial dose, 0.000001 mg.

Course of Disease: The right eye was enucleated, and the patient was discharged to the syphilitic clinic for further treatment. No improvement resulted. In December, 1927 he was readmitted to the Wilmer Institute with a diagnosis of uveitis. There was a positive reaction to 0.001 mg. of tuberculin. Tuberculin therapy was begun in January, 1928, the patient receiving 0.000001 mg. The uveitis of the left eye began to improve one month after treatment was instituted. The

dose was 0.000001 of tuberculin. The patient, who was a mail man, returned to work, continuing treatment. On Feb. 19, 1929, he developed an acute glaucoma, losing vision completely. A trephine operation was performed and on discharge, in March, 1929, tuberculin treatment was continued. At that time, he was given 3 mg. of tuberculin.

Tuberculin Sensitivity After Treatment: November, 1929, positive reaction to 0.001 mg. (mild); marked positive reaction to 0.01 mg.

Maximum Dose of Tuberculin: Present dose, 10 mg.

Duration of Treatment: Twenty-two months except for an intermission of one month.

Result of Treatment: The patient, who has only one poor eye left, has at least had the vision held to the degree that he can carry on his occupation as a mail collector.

Vision After Treatment: 20/70.

Case 9.—G. J. B., a white youth, aged 18.

Diagnosis: Bilateral uveitis; secondary cataract.

Onset: In 1922 the patient was struck in the left eye by a baseball. After two months the vision began to fail. In 1924, he lost the vision of the left eye completely. Because of the failing of vision in the right eye, he came to the Wilmer Institute in October, 1926.

Diagnostic Survey: Negative.

Vision Before Treatment: Right eye, 20/50; left eye, no light perception.

Tuberculin Sensitivity: Positive to 0.001 mg.

Tuberculin Therapy Begun: November, 1926; initial dose, 0.000001 mg.

Course of Disease: Under treatment the acute condition in the right eye began to improve. In December, 1926, vision was 20/20 (one month after the commencement of treatment). In June, 1927, vision was normal, 20/15, in the right eye; the left eye showed no perception to light. A cataract was removed because of the patient's insistence. This operation caused a violent flare-up in the left eye, requiring, as was feared, enucleation of the eye. Pathologic section showed a typical lesion of tuberculosis with marked infiltration of round cells and giant cells in the uveal tract.

Tuberculin Sensitivity After Treatment: In July, 1927, the reaction was positive to 0.01 mg.

Maximum Dose of Tuberculin: 100 mg.

Duration of Treatment: Eleven months.

Result of Treatment: An eye which was gradually developing a tuberculous uveitis was entirely restored to normal. A tuberculous eye was removed and pathologic section confirmed the diagnosis.

Vision After Treatment: Right eye, 20/15.

Case 10.—C. H., a white man, aged 27.

Diagnosis: Tuberculous choroiditis of the left eye.

Onset: In July, 1928, the patient suddenly lost the vision of his left eye. He was admitted to the Wilmer Institute in August, 1928.

Diagnostic Survey: Chronically infected tonsils and adenoids and a number of infected teeth. These foci were removed while the patient was in the institute.

Vision Before Treatment: Right eye, 20/15; left eye, 20/200.

Tuberculin Sensitivity: Positive to 0.001 mg.

Tuberculin Therapy Begun: September, 1928; initial dose, 0.000001 mg.

Course of Disease: The patient was most resistant in responding to treatment. He had had several exacerbations in the left eye. The tuberculin sensitivity is less at present than at the beginning of the treatment. He now fails to

react to 0.001 mg. and to 0.01 mg., although he is still sensitive to 0.1 mg. His eye finally began to show improvement in July, 1929, and continued to improve up to November, 1929.

Tuberculin Sensitivity After Treatment: Positive to 0.1 mg.

Maximum Dose of Tuberculin: 100 mg.

Duration of Treatment: Fourteen months and still under treatment.

Result of Treatment: Problematic.

Vision After Treatment: Not determined.

CASE 11.—B. D. R., a white man, aged 31.

Diagnosis: Chorioretinitis of the right eye.

Onset: In 1919 after reading in a bright light on the shore of a lake, the patient noticed that the shore line appeared to have a break where none existed. Since November, 1926, spots had appeared before the eye. He was admitted to the Wilmer Institute in April, 1927, for examination and study.

Diagnostic Survey: Negative.

Vision Before Treatment: Right eye, 19/20; left eye, 19/15.

Tuberculin Sensitivity: April, 1927, positive to 0.001 mg.

Tuberculin Therapy Begun: April 28, 1927; initial dose, 0.000001 mg.

Course of Disease: Discharged from Wilmer Institute, April 31, 1927, with instructions to take tuberculin at home. Treatment was given at irregular intervals in a haphazard manner. A reaction occurred in December, 1927, following treatment, characterized by dimness in vision and many spots before the right eye. This reaction cleared up after the dose had been reduced. Dec. 23, 1927, vision in the right eye was 20/14; in the left eye, 20/15. The eye was entirely quiescent. In October, 1928, the eyes were in a remarkably quiet condition.

Tuberculin Sensitivity After Treatment: Positive to 0.001 mg.

Maximum Dose of Tuberculin: 100 mg.

Duration of Treatment: Twenty months.

Result of Treatment: Cessation of all activity.

Vision After Treatment: In April, 1928, vision in the right eye was 20/20; in the left eye, 20/20.

CASE 12.—S., a white man, aged 28.

Diagnosis: Tuberculous chorioretinitis.

Onset: In June, 1926, the patient was badly burned. During convalescence he complained of failing vision, particularly in the right eye. Examination revealed a bilateral chorioretinitis. He entered the Wilmer Eye Dispensary in December, 1926.

Diagnostic Survey: Negative.

Vision Before Treatment: Right eye, 20/200; left eye, 20/30.

Tuberculin Sensitivity: December, 1926, positive to 0.001 mg.

Tuberculin Therapy Begun: January, 1927; initial dose, 0.000001 mg.

Course of Disease: In March, 1927, three months after treatment was begun, the eyes improved remarkably. Vision in the right eye was 20/30; in the left eye, 20/30. In July, 1927, treatment was discontinued. Vision in the right eye was 20/20; in the left eye, 20/20.

Tuberculin Sensitivity After Treatment: Positive to 0.01 mg.

Maximum Dose of Tuberculin: 50 mg.

Duration of Treatment: Eight months.

Result of Treatment: The patient returned in June, 1929. His eyes showed numerous vitreous opacities, but no signs of activity in the fundi.

Vision After Treatment: In June, 1927, vision in the right eye was 20/15; in the left eye, 20/20.

CASE 13.—M., a man, aged 38.

Diagnosis: Bilateral tuberculous chorioretinitis; bilateral secondary cataracts.

Onset: The patient had always complained of poor vision. He was first seen in 1920 by Dr. Wilmer, at which time the diagnosis was made. His vision began to fail in 1924 and he lost it completely in October, 1928. He was admitted to Wilmer Institute, on Oct. 31, 1928.

Diagnostic Survey: Negative.

Vision Before Treatment: Right eye, candle 7 feet; left eye, candle 20 feet.

Tuberculin Sensitivity: Positive to 0.01 mg.

Tuberculin Therapy Begun: January, 1929; initial dose, 0.000001 mg.

Course of Disease: The patient on admission had a cataract removed from the right eye. On March 1, 1929, the first real improvement was noted. Vision in the right eye was 15/200; in the left eye, the same as before. At the time this article was written the patient was in the hospital for the removal of the cataract in the left eye. Vision in the right eye is 3/200; in the left eye it was limited to perception of hand movement on Nov. 1, 1929. The fundus could be seen.

Tuberculin Sensitivity After Treatment: Oct. 23, 1929, positive to 0.01 mg.

Maximum Dose of Tuberculin: 5 mg.

Duration of Treatment: The patient is continuing tuberculin therapy, having received it for eleven months.

Result of Treatment: With the one eye the patient can count the number of fingers on a hand at 6 feet. He can see objects at a distance of 10 feet. The outlook is most favorable.

Vision After Treatment: Nov. 10, 1929, vision in the right eye was 7/200; in the left eye, hand movement at 4 feet.

CASE 14.—R., a white man, aged 30.

Diagnosis: Tuberculous retinitis, bilateral.

Onset: In 1916 the patient developed blurred vision in his right eye. Vision was reduced to about 20 per cent. Since 1916 his left eye had been involved in a similar manner on three occasions. Two weeks before he was seen by Dr. Woods a fourth flare-up occurred in the left eye.

Diagnostic Survey: An acute gonorrheal infection with prostatitis was present and was exceedingly resistant to treatment.

Vision Before Treatment: Right eye, 20/100; left eye, 20/40.

Directly in the foveal area of the right fundus discrete spots of atrophic choroiditis with heavy pigment spots could be seen. To the temporal side a sharp mass of connective tissue, which resembled an atrophic tubercle, was visible. In the left eye there was a definite descemetitis and there were heavy veils throughout the vitreous, which greatly blurred the red reflex.

Tuberculin Sensitivity: October, 1927, positive to 0.001 mg.

Tuberculin Therapy Begun: October, 1927; initial dose, 0.000001 mg.

Course of Disease: The patient returned for observation in November, 1927. The infection in the left eye had definitely subsided. The fundus could now be seen, revealing old scarred masses of choroiditis, which had recently taken on fresh activity. Dr. Woods believed that the basis of the condition was tuberculosis with the genito-urinary disease as a contributing cause of the acute flare-up.

On April 23, 1928, the patient was still suffering from gonorrhea. The eye was greatly improved. The right media had become practically clear. The disk was normal in outline. In the foveal area there remained an old retinal tubercle with pigmentation. Scattered throughout the fundus were small areas of disseminated atrophic choroiditis. There was no evidence of activity. The left

media was clear; the disk was clearly seen and normally outlined. The central fundus was normal. In the extreme nasal fundus, there was a large area of atrophic choroiditis with no signs of activity.

Tuberculin Sensitivity After Treatment: Not checked.

Duration of Treatment: Nine months.

Maximum Dose of Tuberculin: 1 mg.

Result of Treatment: When first seen, the patient needed an attendant. At present his vision suffices for normal activity.

Vision After Treatment: Right eye, 20/70; left eye, 20/15.

Case 15.—J. P., a white man, aged 44.

Diagnosis: Chorioretinitis and opacities in the vitreous of the right eye. Detached retina and cataract of the left eye.

Onset: In December, 1916, a black spot appeared before the right eye. In a few days, the spot became a blur. The patient had frequent recurrences of spots and blurring up to the time of admission to the Wilmer Institute, in January, 1926. A tuberculin test was not done. He was readmitted in March, 1928, because of recurring spots before the right eye and increased impairment of vision.

Diagnostic Survey: Negative.

Vision Before Treatment: Right eye, 20/200, corrected; left eye, light perception.

Tuberculin Sensitivity: March, 1928, positive to 0.01 mg.

Tuberculin Therapy Begun: April, 1928; initial dose, 0.000001 mg.

Course of Disease: Gradual clearing up of spots before the eyes. Vision improved and no reaction of any sort occurred from April, 1928, to Nov. 1, 1929.

Tuberculin Sensitivity After Treatment: Positive to 0.01 mg.

Duration of Treatment: Twenty months, from April, 1928, to Nov. 30, 1929.

Maximum Dose of Tuberculin: Receiving 100 mg. each week.

Result of Treatment: No flare-up in eye in eighteen months.

Vision After Treatment: Right eye, 20/100; left eye, 0.

Group 2.—Tuberculous Keratitis.

Case 16.—J. R., a white woman, aged 52.

Diagnosis: Tuberculous keratitis of the left eye.

Onset: In 1925 spots appeared before the left eye. Vision gradually began to fail. The patient was admitted to the Wilmer Institute in June, 1928.

Diagnostic Survey: Negative.

Vision Before Treatment: Right eye, 20/15; left eye, ½/100.

Tuberculin Sensitivity: June, 1928, mildly positive to 0.01 mg.

Tuberculin Therapy Begun: June, 1928; initial dose, 0.000001 mg.

Course of Disease: June 15, 1928, the vision suddenly showed improvement; in the left eye it was 1/60. The patient was discharged from the Wilmer Institute, June 28, 1928, markedly improved. She was readmitted, Aug. 3, 1928, with the eye much worse. Vision in the right eye was 20/20; in the left, ½/80. August 13, the vision in the left eye was ½/200. From August, 1928, to January, 1929, the course was stormy. The patient returned from time to time and the eye progressively became worse. Treatment had been given at home. The solutions had never been properly cared for and the result was a series of reactions following treatment. Finally in February, 1929, the patient began to take treatment under my care. Vision improved. In April, 1929, vision in the left eye was ¼/70. In October, 1929, the eye appeared to be externally normal except for a scar on the lower central portion of the cornea.

Tuberculin Sensitivity After Treatment: Not determined.

Duration of Treatment: Sixteen months.

Maximum Dose of Tuberculin: 100 mg.

Result of Treatment: A healed keratitis.

Vision After Treatment: October 4, 1929, vision in the left eye was 1/4/40; in the right eye, 20/15.

CASE 17.—K., a white woman, aged 50.

Diagnosis: Tuberculous interstitial keratitis (recurring).

Onset: Recurring phlyctenules on the right eye for three years. Phlyctenule on the right eye when first seen; also edema of the lids with conjunctival congestion. The eye presented a most acute appearance. The patient returned in 1929 with the eye much worse, having refused treatment when originally examined.

Vision Before Treatment: Right eye, 20/30; left eye, 20/30.

Tuberculin Sensitivity: November, 1927, positive to 0.001 mg.

Tuberculin Therapy Begun: Failed to carry out treatment until February, 1929. Initial dose, 0.000001 mg.

Course of Disease: The patient remained under treatment, with an uneventful recovery in the keratitis. The small interstitial nodules began to clear up in July, 1929. On October 1, the eye showed no evidence of inflammation.

Tuberculin Sensitivity After Treatment: Positive to 0.001 mg.

Duration of Treatment: Ten months.

Maximum Dose of Tuberculin: 1 mg.

Result of Treatment: Excellent with clearing up of choroiditis. No recurrences.

Vision After Treatment: In October, 1929, vision in the right eye was 20/20; in the left eye, 20/30.

CASE 18.—B, a negress of low mentality, aged 18.

Diagnosis: Bilateral phlyctenular keratitis.

Onset: In September, 1928, the patient complained of redness and lacrimation of the right eye. This continued with exacerbations and remissions up to October, 1928, when she was admitted to the Wilmer Dispensary. She came at irregular intervals for a time until she lost her vision completely and for two months was brought in for treatment by a social worker.

Diagnostic Survey: Negative, except for carious teeth. An acute keratitis involved both eyes.

Vision Before Treatment: Right eye, 3/200; left eye, 10/100.

Tuberculin Sensitivity: December, 1928, positive to 0.001 mg.

Tuberculin Therapy Begun: December, 1928; initial dose, 0.000001 mg.

Course of Disease: The patient had a stormy time at first. She was blind and to make matters worse her eyes failed to improve. On Jan. 9, 1929, the left cornea perforated and she was admitted to a colored hospital, where tuberculin therapy was continued. She remained three weeks and then returned to the Johns Hopkins dispensary for continuation of tuberculin treatment. In April, 1929, vision in the right eye was 4/160; in the left, 20/200. She began to attend the clinic without the guidance of a social worker. In July, 1929, both eyes failed to show any activity. Vision was greatly improved; scar tissue, however, was quite a factor.

Tuberculin Sensitivity After Treatment: October, 1929, positive to 0.01 mg.

Duration of Treatment: Eleven months.

Maximum Dose of Tuberculin: Treatment is being continued, the patient receiving 100 mg. each week.

Result of Treatment: Vision, which had been completely destroyed, was restored, so that the patient was no longer a burden on society.

Vision After Treatment: In September, 1929, vision in the right eye was 5/200; in the left eye, 20/100.

Case 19.—R., a white woman, aged 42.

Diagnosis: Corneal ulcers.

Onset: About April, 1923, corneal ulcers began to occur at irregular intervals, increasing in frequency. The eye was inflamed about every two to three weeks. The patient was seen in the diagnostic clinic, in April, 1929.

General Survey: Negative.

Vision Before Treatment: Right eye, 20/20; left eye, 20/20.

Tuberculin Sensitivity: April, 1929, positive to reaction, 0.01 mg.

Tuberculin Therapy Begun: April, 1929; initial dose, 0.01 mg.

Course of Disease: The patient began treatment, April 22, 1929. Her vision had not been impaired by any ulceration up to November, 1929, with the exception of a mild reaction one month after treatment was begun.

Tuberculin Sensitivity After Treatment: Positive to 0.001 mg.

Duration of Treatment: Still being carried on.

Maximum Dose of Tuberculin: 0.6 mg.

Result of Treatment: Certainly the frequency of ulceration has been reduced.

Vision After Treatment: In October, 1929, both eyes were normal, with the exception of fine scars at the limbus, the result of former ulcers.

Case 20.—C. H. R., a white woman, aged 44.

Diagnosis: Tuberculous keratitis of the left eye.

Onset: For three years the patient had had recurring attacks of keratitis of the left eye characterized by superficial ulceration. The attack would persist three months and was extremely painful. The tonsils and adenoids were removed, but condition recurred after three months. Since the operation she had had recurring ulceration of the left cornea. The present attack failed to respond to local treatment and the patient was referred for study.

Diagnostic Survey: Negative.

Vision Before Treatment: Right eye, 20/20; left eye, 20/50.

Tuberculin Sensitivity: April, 1929, positive to 0.01 mg.

Tuberculin Therapy Begun: April, 1929; initial dose, 0.000001 mg.

Course of Disease: Improvement of a very extensive ulcerating keratitis began four weeks after the beginning of treatment after the patient had received 0.00003 mg. of tuberculin. There has been no recurrence since. On June 10, 1929, Dr. Downey reported that the eyes showed marked improvement. There were very few deposits present in the deep layers of the cornea.

Tuberculin Sensitivity After Treatment: November, 1929, positive to 0.01 mg.

Duration of Treatment: Still receiving treatment after eight months.

Maximum Dose of Tuberculin: Present dose, 0.8 mg.

Result of Treatment: There has been no evidence of any ulceration during a period of eight months. All evidence of corneal involvement has cleared up.

Vision After Treatment: Right eye, 20/20; left eye, 20/20.

Case 21.—L. B., a negress, aged 25.

Diagnosis: Tuberculous bilateral phlyctenular keratitis.

Onset: Since January, 1915, the patient had had repeated attacks of phlyctenular keratitis. She was seen in the Johns Hopkins dispensary on a number of occasions and was given local treatment. In August, 1926, because of most violent photophobia and pain, she was admitted to the Wilmer Institute. An acute bilateral phlyctenular keratitis was found with a corneal ulcer on the left eye.

Diagnostic Survey: Negative, except for several carious teeth.

Vision Before Treatment: Right eye, 20/40; left eye, 20/100.

Tuberculin Sensitivity: Positive to 0.001 mg.

Tuberculin Therapy Begun: September, 1927; initial dose, 0.000001 mg.

Course of Disease: The course was stormy. For several months the patient found it impossible to open her eyes because of the violent photophobia. In May, 1928, definite improvement was noted in the vision. The photophobia cleared up. Vision in the right eye was 20/70; in the left eye, 20/100.

Tuberculin Sensitivity After Treatment: Positive to 0.001 mg.

Duration of Treatment: Twenty-seven months.

Maximum Dose of Tuberculin: Present dose, 8 mg.

Result of Treatment: General improvement in the condition of both eyes. The keratitis has subsided, at least for the time being.

Vision After Treatment: In September, 1929, vision in the right eye was 20/50 + 2; in the left eye, 20/100 + 2.

CASE 22.—C. R., a white man, aged 40.

Diagnosis: Uveitis, left eye; keratitis, left eye, and secondary glaucoma, left eye.

Onset: The patient was admitted to the Wilmer Institute, June 21, 1927. A week before admission the left eye became inflamed and vision had gradually failed. On admission vision in the left eye was 2/200. He had extreme pain in the left eye.

Diagnostic Survey: Infected teeth and infected tonsils were present. These were removed at once without improvement in the eye.

Vision Before Treatment: Right eye, 20/15; left eye, 20/70.

Tuberculin Sensitivity: July, 1927, positive to 0.001 mg.

Tuberculin Therapy Begun: August, 1927; initial dose, 0.000001 mg.

Course of Disease: Two months passed before tuberculin treatment was started as it was considered desirable to await the result of the removal of the foci of infection. Vision became progressively worse and in August, 1927, the initial dose of tuberculin was given. The treatment was characterized by numerous flare-ups in the eye. These reactions frequently necessitated a reduction in the amount of tuberculin given at the subsequent doses.

Tuberculin Sensitivity After Treatment: Positive to 0.01 mg.

Duration of Treatment: Twenty-three months.

Maximum Dose of Tuberculin: 100 mg.

Result of Treatment: No reaction has appeared in the past year. The function of the left eye is excellent.

Vision After Treatment: Right eye, 20/20; left eye, 20/30.

CASE 23.—L., a white man, aged 37.

Diagnosis: Kerato-iritis. Dermatitis from atropine.

Onset: In September, 1926, the patient complained of a fogginess of the vision of the right eye. He paid little attention to this until some months later, when a sharp pain developed through the eyeball. Examination by his physician revealed several ulcers on the right cornea. He was given atropine, and although an extensive dermatitis developed one week after therapy with this drug was begun its use was continued until the patient had a violent dermatitis involving the entire face, neck and upper portion of the chest. He was admitted to the Wilmer Institute on July 27, 1929.

Diagnostic Survey: Negative, excepting for an acute atropine dermatitis, confirmed by the application of an atropine ointment for fifteen minutes to the calf of the patient's leg.

Vision Before Treatment: Right eye, fingers at 4 inches; left eye, 20/50.

Tuberculin Sensitivity: Positive to 0.001 mg.

Tuberculin Therapy Begun: August, 1927; initial dose, 0.000001 mg.

Course of Disease: On admission the left eye was normal; the right eye showed pericorneal injection with a definite interstitial haze over the entire cornea. Two ulcers were present, 2 mm. in diameter. The anterior chamber was shallow; the iris was blurred. The fundus showed only a suggestion of red reflex. After several months of treatment—both local and treatment with tuberculin—the condition improved. The atropine reaction rapidly cleared up. Vision in the right eye improved to 3/200. The iris could be easily seen and the subretinal edema had cleared up. The vessels in the peripheral fundus could be seen.

Tuberculin Sensitivity After Treatment: Not checked.

Duration of Treatment: Eight months.

Maximum Dose of Tuberculin: 100 mg.

Result of Treatment: Most satisfactory.

Vision After Treatment: Right eye, 3/200; left eye, 20/50.

Group 3.—Tuberculosis of the Sclera.

Case 24.—S., a white woman, aged 35.

Diagnosis: Tubercle in the sclera.

Onset: Two weeks before the onset, the patient's right eye became inflamed. Then a nodule appeared. The patient gave a history of having had tuberculous glands of the neck removed a year before. Examination showed a typical tuberculous nodule in the sclera.

Diagnostic Survey: Negative.

Vision Before Treatment: Right eye, 20/40; left eye, 20/20.

Tuberculin Sensitivity: July, 1926, positive to 0.001 mg.

Tuberculin Therapy Begun: July, 1926; initial dose, 0.000001 mg.

Course of Disease: The nodule in the sclera began to improve three weeks after the commencement of treatment. After five months of treatment it had completely disappeared.

Tuberculin Sensitivity After Treatment: In March, 1929, the reaction was positive to 0.01 mg.

Duration of Treatment: Nine months.

Maximum Dose of Tuberculin: 100 mg.

Result of Treatment: Complete clearing up of the nodule.

Vision After Treatment: Right eye, 20/15; left eye, 20/15.

Group 4.—Tuberculous Iritis.

Case 25.—G. P., a white man, aged 40.

Diagnosis: Recurring attack of tuberculous iritis.

Onset: The patient was first seen in April, 1927, by Dr. Clapp because of repeated attacks of iritis over a period of four years. The right eye showed an old iritis with an acute exacerbation.

Diagnostic Survey: Negative.

Vision Before Treatment: Right eye, 20/40; left eye, 20/16.

Tuberculin Sensitivity: June, 1927, positive to 0.001 mg.

Tuberculin Therapy Begun: June, 1927; initial dose, 0.000001 mg.

Course of Disease: An uneventful course of treatment was begun in December, 1928.

Tuberculin Sensitivity After Treatment: Still positive to 0.001 mg.

Duration of Treatment: Nineteen months.

Result of Treatment: No attack of iritis has occurred since April, 1927.

Vision After Treatment: In November, 1929, vision in the right eye was 20/20 +; in the left eye, 20/16.

Group 5.—Intra-Ocular Hemorrhages (Recurring).

CASE 26.—R. R., a man, aged 23.

Diagnosis: Retinitis of the right eye with vitreous hemorrhage.

Onset: In December, 1927, the patient complained of localized headaches over the right eye, followed in six days by loss of vision as a result of hemorrhage. He was admitted to the Wilmer Institute in February, 1928.

Diagnostic Survey: Negative.

Vision Before Treatment: Right eye, 1/200; left eye, 20/15.

Tuberculin Sensitivity: February, 1928, positive to 0.01 mg.

Tuberculin Therapy Begun: Feb. 3, 1928; initial dose, 0.000001 mg.

Course of Disease: The patient showed his first improvement on February 25, twenty-two days after the beginning of treatment, having reached a dosage of 0.00002 mg. He was discharged from the Wilmer Institute, March 3, 1928, with vision in the right eye, 1/100; in the left, 20/15. Treatment was continued at home until July, 1928, when he was readmitted because of another small hemorrhage. Vision in the right eye on admission was hand motion at 1 foot; in the left eye, 20/20. The hemorrhage occurred after 1 mg. of tuberculin. The dosage was reduced to 0.1 mg., the hemorrhage cleared up and vision improved. In December, 1928, another small hemorrhage occurred in the right eye, clearing up after the dosage of tuberculin was reduced.

Tuberculin Sensitivity After Treatment: Positive to 0.01 mg.

Duration of Treatment: Nineteen months.

Maximum Dose of Tuberculin: 7 mg.

Result of Treatment: No hemorrhages in thirteen months. Improved vision.

Vision After Treatment: In November, 1929, the patient reported that his vision had been excellent. No hemorrhage had occurred in thirteen months. Tuberculin had been discontinued in August, 1929. In May, 1929, vision in the right eye was 1/40; in the left eye, 20/15.

CASE 27.—L. B., a man, aged 37.

Diagnosis: Intra-ocular hemorrhage, bilateral, tuberculous.

Onset: In May, 1923, sudden blurring of vision occurred in the left eye (hemorrhage). In August, 1924, there was a gradual loss of vision of the right eye. From this time on there were numerous hemorrhages in both eyes until the patient was admitted to Wilmer Institute in October, 1925.

Diagnostic Survey: Negative.

Vision Before Treatment: Right eye, blind; hemorrhage day before admission. Left eye, blind; hemorrhage day before admission.

Tuberculin Sensitivity: In October, 1925, positive to 0.001 mg.

Tuberculin Therapy Begun: November, 1925; initial dose, 0.000001 mg.

Course of Disease: On Nov. 16, 1925, the patient showed rapid improvement in the two eyes with absorption of hemorrhages. On Jan. 25, 1926, conjunctivitis developed after 0.00008 mg. of tuberculin. The subsequent dose was reduced to 0.00001 mg. Feb. 12, 1926, vision in the right eye was ¼/100. On March 3, 1926, fingers could be seen at 6 inches with the right eye; vision in the left eye was 20/30. On March 12, 1926, the patient was able to walk without difficulty and could read. He was discharged on April 28, 1926, greatly improved. Tuberculin was continued after discharge. He was readmitted on Nov. 11, 1926. Vision in the right eye was ½/200; in the left eye, 20/20 — 3. Treatment was continued until September, 1927.

Tuberculin Sensitivity After Treatment: Positive to 0.001 mg.

Duration of Treatment: Twenty-two months.

Maximum Dose of Tuberculin: 100 mg.

Result of Treatment: The patient believes that he has vision as useful as that of the average citizen. He has not had hemorrhage during the past three years.

Vision After Treatment: Right eye, 20/15; left eye, 20/20.

CASE 28.—T., a white boy, aged 19.

Diagnosis: Intra-ocular hemorrhage, tuberculous, bilateral. Detached retina. Secondary glaucoma.

Onset: In March, 1925, an injury to the right eye caused dimness of vision. The dimness of vision in the eye increased in degree and finally in November, 1925, he came to the Johns Hopkins dispensary.

Diagnostic Survey: Negative.

Vision Before Treatment: Right eye, light perception; left eye, 20/30.

Tuberculin Sensitivity: Positive to 0.01 mg.

Tuberculin Therapy Begun: November, 1925; initial dose, 0.00001 mg.

Course of Disease: The patient had a very stormy course. From time to time he had recurring hemorrhages. In March, 1926, he suddenly lost the vision in his left eye as a result of a detachment of the retina. From time to time treatment was omitted entirely for several weeks because of the extensive hemorrhages. In October, 1926, it was necessary to enucleate the right eye. Vision in the left eye was 20/40 at the time of discharge from the Wilmer Institute. In January, 1927, the tuberculin reaction was positive to 0.01 mg. It was decided, because of the seriousness of the situation, to begin treatment again with 0.000001 mg. The eye began to quiet down immediately.

Tuberculin Sensitivity After Treatment: In June, 1929, the reaction was positive to 0.01 mg.

Duration of Treatment: Three years with one year's intermission.

Maximum Dose of Tuberculin: 100 mg.

Result of Treatment: A fairly well restored left eye.

Vision After Treatment: In October, 1929, vision was 20/40 + 1.

CASE 29.—W., a white man, aged 25.

Diagnosis: Bilateral intra-ocular hemorrhages.

Onset: In 1915, the patient had his first hemorrhage in the left eye. Vision was completely lost for four weeks. He had frequent recurrences of hemorrhages in both eyes between 1915 and 1927. He was admitted to the Wilmer Institute in January, 1927.

Diagnostic Survey: Negative.

Vision Before Treatment: Right eye, 19/15; left eye, 1/200.

Tuberculin Sensitivity: Positive to 0.001 mg.

Tuberculin Therapy Begun: February, 1927; initial dose, 0.000001 mg.

Course of Disease: The patient had a hemorrhage shortly after being given treatment. This soon subsided and he returned to his home with instructions for tuberculin therapy. On Nov. 1, 1929, he reported that there had not been any hemorrhages since he left Baltimore, in March, 1927. He has continued tuberculin to the present date.

Tuberculin Sensitivity After Treatment: Not determined recently.

Duration of Treatment: Two years.

Present Dose of Tuberculin: 30 mg.

Result of Treatment: No hemorrhages in the eyes from March, 1927, to Nov. 11, 1929. Vision partially restored.

Vision After Treatment: Not checked recently, although the patient writes that he lives a perfectly normal, active life with few spots before his eyes.

CASE 30.—C. C., a white man, aged 32.

Diagnosis: Intra-ocular hemorrhages; choroiditis.

Onset: In December, 1925, a dark cloud appeared before the right eye. In September, 1926, a dark cloud appeared before the left eye. From December, 1925, to January, 1927, severe acute exacerbations appeared first in one eye, then the other. The patient entered Wilmer Institute in October, 1926.

Diagnostic Survey: Chronic tonsillitis.

Vision Before Treatment: Right eye, hand motion at 8 inches; left eye, 2/200.

Tuberculin Sensitivity: Positive to 0.001 mg.

Tuberculin Treatment Begun: First course in October, 1926. Initial dose, 0.000001 mg.

Course of Disease: Improvement of eye with absorption of hemorrhages. Treatment continued until June, 1927. Vision in August, 1927, right eye, 20/70; left eye, 20/20. The patient returned after one year with pain in the left eye. On examination there was evidence of a small hemorrhage. Began tuberculin therapy again in June, 1928.

Tuberculin Sensitivity After Treatment: June, 1928, positive to 0.01 mg.

Duration of Treatment: Twelve months, first course; six months, second course.

Maximum Dose of Tuberculin: 100 mg.

Result of Treatment: Examination revealed vitreous opacities and some haziness of the fundi. There had been no recurrence of symptoms in one and a half years. Vision was excellent.

Vision after treatment in November, 1929, was 20/50 in the right eye; 20/30 in the left.

COMMENT

Analysis of the cases in the protocols shows a variety of seriously diseased eyes. The ages of the patients vary between 18 and 54 years. Their social status is quite mixed, and negroes as well as white persons are included. Of the entire group, no patient has been made worse by treatment. In the majority of instances, the result of treatment has been the restoration of an eye or eyes supposedly beyond repair. The patients have not been under observation long enough to permit a discussion of the ultimate prognosis of the diseased eye. Flare-ups may appear as time goes on. However, a remission has resulted from the method of treatment employed; the improvement can hardly be considered coincident nor, as Derby and Carvill [13] termed it, purely spontaneous recovery as a result of psychotherapy and improved hygiene. Certainly one must not use the word "cure" in this disease, but it seems to me that the word "arrested" can be applied to a healed tuberculous eye in the same manner as it is applied to tuberculosis of the lung or any other similarly diseased tissue.

From the standpoint of the skin reaction to tuberculin before and after treatment, certain information has been obtained concerning the

patients who have been subjected to prolonged treatment. Many investigators in the field of allergy found that persons who gave an extremely violent reaction to an intradermal injection of pollen antigen showed comparatively little reduction in reaction following a prolonged course of treatment, although the seasonal symptoms might be greatly diminished or even entirely relieved. In twenty-five patients in this series retested after tuberculin treatment, similar comparisons have been made, and it has been found that in only nine was there any appreciable change in the sensitivity of the skin to tuberculin. None of them lost the skin reaction. Attention is called particularly to this feature of the report, as there is ample evidence that allergy as tested by the skin reaction to tuberculin may diminish after the administration of gradually increasing doses of tuberculin. Why in some cases this is impossible and how, when successful, the change is brought about, are points as yet not clearly understood. In these specific instances, it is noteworthy that each of the nine persons who showed a diminished reaction had finally received maximum doses of from 50 to 100 mg. No attempt to explain the variations in sensitivity of the skin to tuberculin will be made in this paper; the reader is referred to the admirable studies of Hamman and Wolman [15] and to the monograph of Rich and McCordock [16] for the theoretical and experimental considerations bearing on tuberculosis and allergy.

SUMMARY

1. Thirty patients with ocular tuberculosis—choroiditis, chorioretinitis, uveitis, scleritis, iritis and intra-ocular hemorrhages—were treated with the tuberculin of Denys.

2. Tuberculin may be used intradermally as a diagnostic method and subcutaneously as a safe method of treatment.

3. The use of minute doses of old tuberculin (0.001 mg.) in the diagnosis of the disease is more accurate and is safer than the use of large doses (from 1 to 5 mg.).

4. The treatment consists of subcutaneous injections of bouillon filtrate, beginning with 0.000001 mg. and gradually over a period of months reaching a maximum dose of 100 mg. The maximum dose should then be repeated at weekly intervals for at least three months.

5. The use of a bacillus emulsion leads to inaccuracy because of the infinitely small dilutions which are used in this treatment (1 : 100,000,000).

6. Constant observation of the eyes is of the greatest importance. A focal reaction should be avoided; if it occurs, the subsequent dose should be reduced to a level of safety.

7. The thirty patients presented here are a selected group who had been treated unsuccessfully by other ophthalmologists before they were admitted to the Wilmer Clinic. In this clinic no abnormality was found, other than tuberculin hypersensitivity, to account for the disease. The result of treatment has been restoration of impaired vision with the arrest of a disease which ultimately would have blinded the patient.

8. In my opinion, tuberculin does not produce healing by a non-specific reaction; the healing is due possibly to an immunologic desensitization of diseased tissue.

9. In order that patients with ocular tuberculosis may be properly treated, ophthalmologists must appreciate the wide difference between immunologic antigens and chemical reagents.

10. The use of tuberculin should never be considered in the treatment of a patient with a diseased eye unless all foci of infection have been removed. It should be used if after a lapse of from three to six months the removal of infection fails to bring about improvement.

MELANOSIS UVEAE AND MELANOMA OF THE IRIS IN NEUROFIBROMATOSIS (RECKLINGHAUSEN) *

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Recklinghausen [1] in 1882 described melanoma in conjunction with multiple fibromas of the skin, the latter arising from cutaneous nerve filaments. It was soon found that fibromatous and the equally characteristic neurofibromatous lesions were not limited to peripheral nerves, but that such overgrowth could involve many portions of the nervous system. Moreover, the disease was related to a host of anomalies and associated disturbances, such as elephantiasis, pigmented plaques and small tumors of the skin, and in the nervous system to epilepsy, idiocy, defects in the special senses and endocrine disorders. For these reasons, Ewing [2] spoke of a congenital malformation of ectoderm leading to one or more manifestations under a variety of exciting causes.

The orbit and the eye with its appendages have been found to exhibit these tendencies to a remarkable degree. Localized neurofibroma of the orbit and surrounding parts is fairly frequent. Less frequently, pigmented nevi of the lids and face have been seen as well. Most interesting is the association with hydrophthalmos and buphthalmos, and with elephantiasis of the lids and structures of the face on the same side. As regards buphthalmus, Snell and Collins [3] found thickening of the scleral, corneal and uveal tract nerves, overgrowth of the iris and defects in the pectinate ligament to explain the anomalous condition of the eye. Michel [4] spoke of fibroma of the ciliary nerves, and credited the rise in tension to fibrous change in

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* From the Laboratories and Ophthalmological Division of the Mount Sinai Hospital.

1. Recklinghausen: Ueber die multiple Fibrome der Haut, Berlin, 1882.
2. Ewing, James: Neoplastic Diseases, Philadelphia, W. B. Saunders Company, 1919.
3. Snell and Collins: Plexiform Neuroma of Temporal Region, Orbit, Eyelid and Eyeball, Tr. Ophth. Soc. U. Kingdom **23**:157, 1903.
4. Michel, Julius: Buphthalmus und halbseitiger Gesichtehypertrophie, Ber. d. ophth. ges. Heidelberg, 1908.

the angle of the anterior chamber. Sachsalber [5] attributed the buphthalmos in his case to primary disease of the choroidal lymph and blood vessels. Such defects have been postulated [6] to explain also the association of buphthalmos and of acquired glaucoma with hemangioma or vascular nevus (so-called nevus flammeus), since it is established that nevi about the head are associated with anomalies of the eye.

There are many clinical reports of pigmented areas in the sclera and conjunctiva, with a dark iris alone or with melanotic tumors of the choroid and cilary body. Also, melanosis of the uvea has been described histologically together with or independent of melanotic neoplasm. Iris melanomas are, however, in intimate relation to melanosis of the iris and other portions of the uvea. Several cases of melanosis of the iris are recorded in which prominences of various sizes and shapes have been seen on the surface of the iris. Coats [7] in 1912 applied the term "golf ball iris" as best describing the excrescences on the iris in a case of melanosis of the uvea. The Friedenwalds [8] referred to the wartlike growths in the iris as resembling a field of stubble or deforested landscape where only stumps of trees remain, while the lids, conjunctiva and sclera were melanotic. A few such cases clinically observed have come to section, for the most part complicated by glaucoma. Wood [9] in 1928 described such a case in which the surface of the iris, in addition to numerous melanotic nodules, was covered with a hyaline membrane consisting of embryonal tissue. Treacher Collins considered that persistence of portions of the iridopupillary membrane following its imperfect separation from the back of the cornea could be responsible for the protrusions on the iris in this case.

The following report illustrates the structure of melanosis and iris melanoma occurring in both eyes in a case of widespread neurofibromatosis, in which in addition fibrosarcoma and a distinct endocrine disorder were prominent features.

REPORT OF A CASE

History.—An unmarried woman, aged 21, a native of Austria, was admitted to the neurologic service of Dr. I. Strauss with a history of sudden onset of pain in the thighs, urinary and rectal retention, inability to walk, and skin tumors said

5. Sachsalber: Ueber die Rankenneurom der Orbita mit secondären Hydrophthalmus, Beitr. z. Augenh. **27**, 1891.

6. Nakamura: Angeborene halbseitiger naevus flammeus mit Hydrophthalmus, Klin. Monatsbl. f. Augenh. **69**:312, 1922.

7. Coats: Unilateral Melanosis of the Uvea with Elevations of the Surface of the Iris, Tr. Ophth. Soc. U. Kingdom **32**:165, 1912.

8. Friedenwald and Friedenwald: Melanosis of Lids, Conjunctiva and Sclera, with Wartlike Growths on the Iris, Arch. Ophth. **54**:51, 1925.

9. Wood: Melanosis of the Surface of the Iris with Hyaline Membrane Formation, Brit. J. Ophth. **12**:140, 1928.

to be of two months' duration. There were striking features of acromegaly, typical skin lesions of Recklinghausen's disease, including soft pedunculated tumors, and flat and raised pigment spots. A soft paravertebral mass occupied the left side next to the scapula. Signs of a compression myelitis developed, probably a result of invasion of the spinal cord by the tumor. Biopsy of the skin nodules showed fibroma and neurofibroma. That of the mass on the back was reported as "fascial fibrosarcoma." The diagnosis was Recklinghausen's disease and, on account of the distinctly low mentality and the acromegalic signs, involvement of the brain and of the pituitary body as well.

Fig. 1.—Pigmented neurofibromas. The face and the hands are distinctly acromegalic.

Examination and Course.—There was coarse pigmentation of the skin of the lids, but no spots were seen on the conjunctiva or sclera. Both corneas were greatly infiltrated and vascularized, precluding satisfactory study of the iris; only its dark brown color could be made out. Beyond the fact that the fundi were highly myopic, no details could be seen. The tension of both eyes was normal. Some vision was present in each eye. The exact amount could not be determined.

There was a progressive downward course hastened by the infection of the bladder and of the kidney. At autopsy, sarcoma of the left paravertebral region was seen, with metastatic tumor of the lung, bilateral purulent bronchitis, chronic

cystitis and pyelonephritis and multiple neurofibromatosis of the skin. Most careful search by Dr. J. Globus failed to reveal lesions in the brain or in the pituitary gland.

Microscopic Examination.—Microscopic study of the ocular structure revealed the changes shown in the accompanying illustrations.

Figure 3 shows that the inner portion of the sclera at the posterior pole was studded with spindle-shaped cells pigmented brown. Some surrounded the vessels and the nerve head. The entire choroid was heavily pigmented, more so at

Fig. 2.—Multiple neurofibromas, pigment spots, and tumor over the left scapula.

the posterior pole and in its external half. The pigment cells were irregularly round and spindle-shaped, tended to be a deep brownish black, and occurred as single cells, irregular groups and in layers.

Figures 4 and 5 illustrate the pigmented growths on the various portions of the anterior surface of the iris as well as the hyperpigmentation in various layers. Figure 6 shows that the posterior pigment layer of the inner third of the iris was thickened to almost twice its normal size and ended at the pupillary margin in a club-shaped extremity (ectropion uvea). The corresponding portion of the anterior iris endothelium had undergone hyperplasia to form a large spindle-shaped mass consisting of deeply pigmented spindle cells. The vascular layer contained a mass of large round and irregularly shaped densely pigmented cells.

These had no processes and had the characters of clump cells. These cells had coarse granules. There was no evidence of round cell infiltration, new vessel formation or karyokinesis. The cells appeared to be approximately of equal size. The stroma cells bore the usual number of faintly pigmented processes.

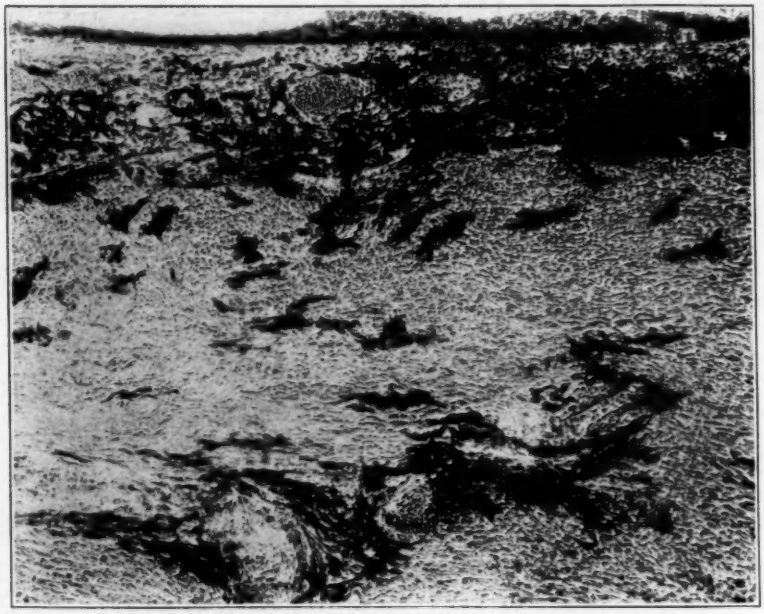

Fig. 3.—Melanosis of the choroid and sclera at the posterior pole of the eye.

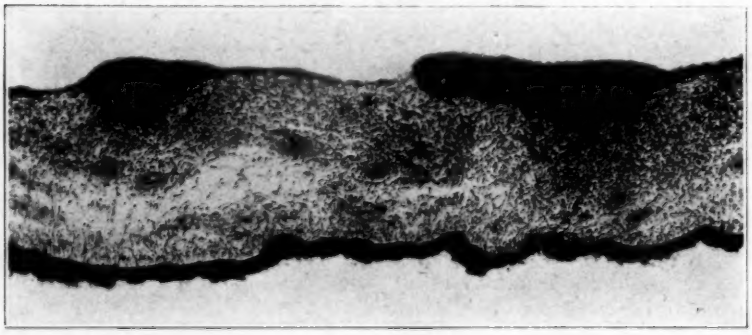

Fig. 4.—Deeply pigmented melanotic nodules on the surface of the iris.

The multiplicity of the iris nodules is shown in figure 7. These growths consisted for the most part of spindle cells and extended farther into the stroma than into the anterior chamber. The portion extending into the stroma contained threadlike cells with few processes, and small round pigmented cells. These were much smaller and less pigmented than the clumplike type of cells often seen in

the posterior layers adjacent to the dilator muscle. The ciliary body and its processes, and the pectinate ligament were considerably hyperpigmented.

A similar growth of the anterior layer near the pupillary area, showing clearly its pigmented spindle cell structure, is shown in figure 8. The cells were more numerous and closely packed on the posterior than on the anterior border of the lesion. The growth contained a few small blood vessels. A few clumplike cells were enclosed in the mass, but at its posterior border they were grouped more definitely along its entire extent and appeared to be continuous with the anterior pigment epithelium. A bleached specimen showing one of these growths free of pigment revealed it to be composed of spindle cells with a large amount of intercellular substance.

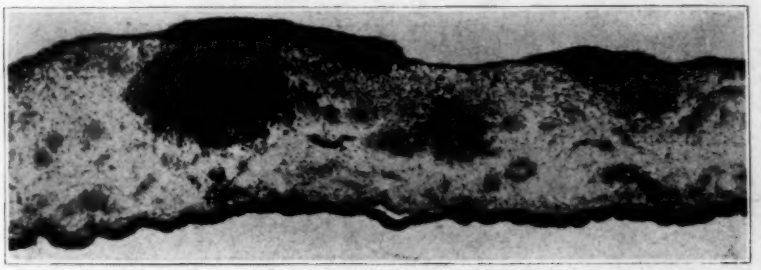

Fig. 5.—Melanoma of the surface and deeper layers of the iris; the clumplike cells are prominent at the edges.

Fig. 6.—Melanosis at the pupillary margin, with thickened posterior pigment epithelium, slight ectropion uveae, and dense anterior pigment layer.

Figure 9 shows a solitary island of deeply pigmented tissue in the central layers of the middle third of the iris. It was composed of groups of fused quadrilateral cells without dendritic processes, separated by intercellular substance. The periphery was occupied by smaller clumplike cells. The pigment in these cells was coarse and dark; in the central compact groups it was fine and lighter. Again, no round cell infiltration, blood vessels or evidence of cell division was seen.

COMMENT

With regard to the skin, Ewing,[2] in his textbook, used the term nevomelanoma to denote the pigmented nevus having as its basis nevus cells most likely epidermal in origin. The relation of chromatophores

to nevomelanoma is not clear; yet theoretical considerations favor the origin of all melanomas from mesoblastic chromatophores, while the histology of tumors favors their origin from epithelial cells which have taken on pigmentary functions.

The origin of melanoma in the iris is even more difficult to explain. Fuchs [10] questioned the use of the term pigmented nevus as applied to the eye, since nevus cells are absent. This would leave the production of pigmented tumors directly to pigmented and fixed tissue cells. In the case of pigmented nodules on the surface of the iris, one has to consider the anterior endothelial cells, the flat cells of the underlying limit-

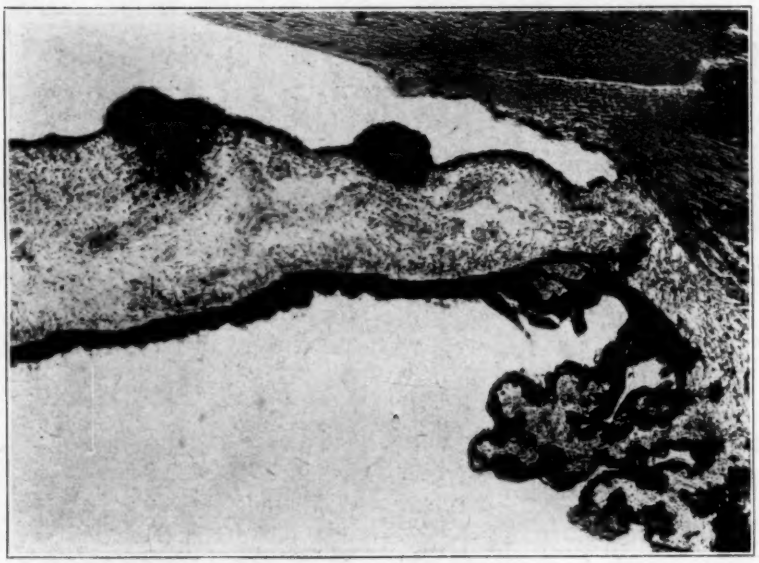

Fig. 7.—Nodules on the iris near the angle. The pectinate ligament is pigmented; the ciliary body and its processes are hyperpigmented.

ing membrane and the pigmented and nonpigmented stroma cells. The best view holds the endothelial layer to be ectodermal and the other cells, including the dendriform chromatophores of the stroma, to be mesodermal in origin. The mesodermal origin of the chromatophores seems to be well established, although some authors, Treacher Collins [11] for one, hold that the epiblastic origin of some pigment cells in the iris cannot be excluded. From the spindle cell structure of the nodules in this case one cannot with safety argue derivation from the endothelial

10. Fuchs, E.: Naevus Pigmentosus and Naevus Vasculosus der Iris, Arch. f. Ophth. **86**:155, 1913.

11. Collins, Treacher: Discussion on Intra-Ocular Melanomata, Tr. Ophth. Soc. U. Kingdom **46**:104, 1926.

cells or the cells of the limiting membrane. A distinct possibility is the assumption of pigment production by the endothelial cells. More likely is the multiplication of the pigmented cells in the normally pigmented limiting membrane. Fuchs [10] stated that pigment spots on the iris occur only in pale blue or gray irides. This would strongly favor their

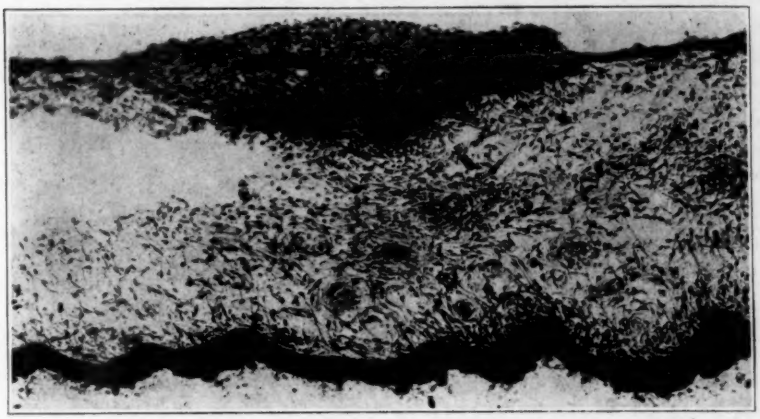

Fig. 8.—Moderately pigmented melanoma iris, with spindle cells, a few blood vessels, endothelial cells on its surface and clumplike type of cells on its posterior border.

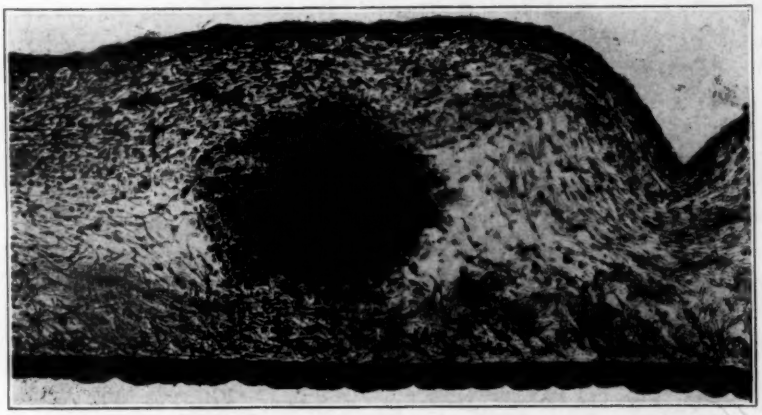

Fig. 9.—Isolated nodule of fused pigment cells, surrounded by clumplike cells.

origin from the mesododermal chromatophores of the stroma, since the anterior limiting membrane of such irides contains little or no pigment. However, the thickened anterior pigment layer and the apparently isolated nodules of pigment cells in the middle layers of the iris in this case may be considered to be quite definitely primary melanosis due to an increase of pigment or pigment cells of mesodermal origin.

That there is some relation between melanosis and malignant tumors is indicated by the fact that Coats [7] noted seven instances of melanotic sarcoma in twenty-six cases of diffuse melanosis of the uvea. Heine [12] reported nevus and sarcoma in the same portion of the iris, in intimate contact, and with evidence of transition from the benign to the malignant form. Fuchs [13] stated the belief that the change from nevus in the iris to sarcoma has never been demonstrated with certainty, and that melanosis is merely incidental to sarcomatous growths. As regards the fibrosarcoma of the back in the present case, it is established beyond reasonable doubt that neurofibroma occasionally undergoes sarcomatous degeneration.[14]

Clump cells and the clump type of cell noted in the case reported here offer an interesting study. Those found normally at the edge of the sphincter and along the posterior border of the iris have been shown by Elsching and Lauber [15] to be derived from the retinal iris epithelium. Fuchs states that they occur also from chromatophores physiologically, and in old iritis and glaucoma pathologically. There can be no doubt of the strong resemblance of the clumplike type of cell in the melanotic iris to these ectodermal clump cells. Reese [16] called attention to this fact and considered the clump cells in his case of melanosis to be derived from mesodermal chromatophores which had been become swollen with pigment and lost their processes. In this view he is supported by Treacher Collins,[11] who also ascribed a phagocytic property to those mesodermal cells which take up melanin pigment derived from degenerating epithelial cells. It would seem preferable, therefore, to speak of clumplike cells in order to distinguish the normal from the pathologic cells such as occur in melanosis and melanoma, whether the latter are ectodermal or mesodermal in origin.

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12. Heine: Zur Melanose und Sarkose der Iris, Arch. f. Ophth. **113**:417, 1924.
13. Fuchs, E.: Ueber Pigmentierung Melanoma und Sarkom der Aderhaut, Arch. f. Ophth. **94**:50, 1916.
14. Kaufmann, Eduard: Lehrbuch der speziellen pathologischen Anatomie für Studierende Aerzte, Berlin, G. Reimer, vol. 2, p. 1568.
15. Elsching and Lauber: Ueber die sogenannten Klumpenzellen der Iris, Arch. f. Ophth. **65**:428, 1907.
16. Reese, A. B.: Melanosis Oculi, Am. J. Ophth. **8**:865, 1925.

GLAUCOMA

FACTORS UNDERLYING SUCCESS IN TREPHINING*

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AND

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The general feeling of pessimism concerning the results obtained by the surgical treatment of patients with glaucoma seems sufficient justification for this paper. Our experience, until three years ago, was in agreement with that recently reported by Parker and others and led to the trial of the various surgical procedures but without raising the general average of successful operations above that of other operators.

In 1927, we started an investigation to determine which of the different operations for glaucoma gave the best results. The cases studied date back to 1911. It was found that the results were slightly in favor of trephining and were better during the earlier than during the later years of our practice, when greater experience should have resulted in better operations. We were at first unable to explain why in similar eyes and apparently following the same technic, one trephining should prove successful while another was a failure. Finally three patients were found who had both eyes operated on with rather unusual experience. In one eye the tension was permanently reduced by one operation, while the other eye required two or three operations to obtain a similar result. Investigation revealed the fact that when success was obtained the iridectomy was invariably small and peripheral, so that it was almost invisible. This was contrary to what we expected, as we had always striven to obtain a visible and good-sized iridectomy. In fact when the iridectomy was what we considered too small, we generally tried to enlarge it if the patient was sufficiently tractable. This was in accord with the practice of the leading authorities. The small peripheral iridectomies were practically all accidental, because the patient was so unruly that it was considered unsafe to continue. This also explained why the earlier results were better, because less skill and greater timidity prevented us from doing more manipulating than we did subsequently.

During the past three years, we have purposely endeavored to obtain a small peripheral iridectomy or iridotomy and have evolved a technic

* Submitted for publication, Jan. 29, 1930.

that differs from Elliot's in several steps. The results in chronic and in acute glaucoma have been more than 90 per cent successful.

For the past six months one of us has been doing the peripheral iridectomy while the other one was doing a peripheral iridotomy as a control and when possible on the other eye of the patient. Iridotomy is easier to perform, and the results have been fully as good if not better.

We are not yet prepared to recommend it for secondary glaucoma, but for acute and chronic glaucoma it is by far the best operation.

METHOD

One hour before operation, 3 drops of 0.25 per cent physostigmine salicylate, U. S. P., are instilled into the eye at intervals of ten minutes. The pupil must be contracted to the size of a pinpoint if possible in order to minimize the prolapse of the iris before iridectomy. The deep structures of the eye are anesthetized by the intra-orbital injection of 1 cc. of 4 per cent procaine hydrochloride, followed by 1 drop of 4 per cent cocaine solution, which is instilled in the culdesac every five minutes until 3 or 4 drops are given.

The size of the trephine depends on the tension of the eye. If the tension is low, 50 degrees McLean or less, a 2 mm. trephine is used, but for general use a 1.5 mm. trephine is the right size. If the tension is high or the pupil fails to contract to less than 3 mm., a 1 mm. trephine should be used.

A trephine that is superlatively sharp is absolutely essential to the success of the operation. Examination of the trephines as they come from the manufacturers shows practically all of them to be dull or improperly sharpened. If a trephine is to cut properly, it must have microscopic saw teeth. But as trephines are usually sharpened by a rotary motion at right angles to the blade, no saw teeth are produced. The stroke in sharpening should be parallel to the long axis of the blade. The operation will be more easily performed with a trephine, the handle of which is sharped so as to reduce pressure and wobbling of the eye to a minimum. This may be accomplished to a great extent with a trephine that permits the operator to rest his hand on the patient's head while the trephine is held delicately between the thumb and second finger, the index finger steadying the trephine by resting on the movable disk at the top, as a watchmaker uses his delicate screwdriver. The trephines that are manipulated with the thumb and index finger permit of no such delicacy. They cause too much pressure, impart too much motion to the eye as the trephine is rotated and do not permit placing of the hinge with a sufficient degree of accuracy. The best trephine to use, one that causes the least pressure and is placed on the eye with the greatest accuracy, is an automatic trephine of the von Hippel type.

In placing the trephine the conjunctiva is dissected down and the cornea split as directed by Elliot. In dissecting the conjunctiva, the forceps holding the flap is not to rest on the cornea but is to be held up lightly. No assistant must fix the eye with forceps.

We now come to the first real difference in technic from that of Colonel Elliot. The trephine is to be so placed that is leans toward the scleral instead of the corneal side, so that the hinge of the disk is at the limbal instead of the scleral side. This is all important and makes the subsequent steps much easier.

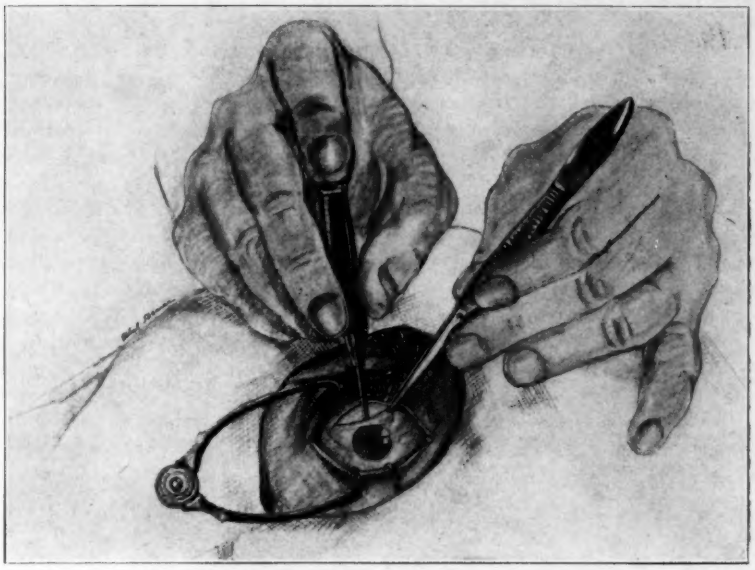

Fig. 1.—Methold of holding trephine.

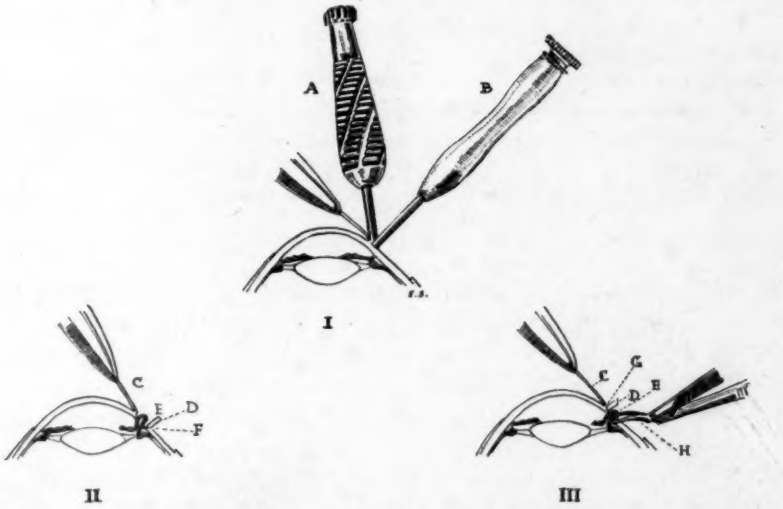

Fig. 2.—I, *A* indicates trephine and angle of Elliot (exaggerated), *B*, trephine; II, *C*, conjunctival flap; *D*, disk attached at *F*, and *E*, prolapsed iris (exaggerated); III, *C*, conjunctival flap, *D*, disk attached at *G*, *E* prolapsed iris (exaggerated) and *H*, *iridotomy* with point of scissors.

During all this time all pressure on the eyeball must be carefuly avoided, and the conjunctival flap must be held up with forceps and not be permitted to rest on the cornea.

Next comes the most important step of the operation and one on which, in conjunction with the previous steps, the success or failure of the operation will depend. The moment the iris prolapses into the trephine opening, the iridotomy or iridectomy is to be performed without permitting the prolapse to increase, and this must be done without taking hold of the iris with forceps. Should the operator ignore this point and grab the iris with forceps, the operation will probably be a failure. All that is necessary is to snip the iris at the scleral side of the opening or to cut off the smallest possible piece of iris before removing the disk of sclera. The latter should be done only after the iris has resumed its position in the anterior chamber. As a rule, the pupil will be found to have resumed its normal shape and size without further manipulation. If not normal, the eyeball may be quietly massaged under the lid, and after the pupil has become round, the disk is cut off. Nothing must be introduced through the trephine opening, nor is it necessary to cut off the entire disk. A water-tight suture is

Fig. 3.—Two large iridectomies above (unsuccessful) and small iridectomy below (successful).

used to close the conjunctiva, the culdesac is filled with 1 per cent atropine ointment and the eye is closed. The after-treatment consists of daily instillations in the eye of 1 per cent atropine and 10 grains (0.65 Gm.) of acetylsalicylic acid by mouth three times a day, until all ciliary reaction has subsided.

COMMENT

The advantages of trephining over other operations for glaucoma are: (1) it is the most successful; (2) it is easy to perform; (3) it leaves the eye without disfigurement. The fear that some ophthalmologists have of later infection is, in our opinion, unjustified; at any rate its occurrence is so rare that it should have no deterring effect. If proper aseptic technic is used during the operation and the conjunctival flap is made as thick as possible, no infection is to be expected. Personally we have not seen a single case. Colonel Elliot told us that in all of his experience he has had only one or two postoperative infections. The postoperative infections in trephining are no more frequent than in operations for cataract.

BLASTOMYCOSIS OF THE EYE*

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Blastomycosis or blastomycetic dermatitis is a chronic disease of the skin caused by a fungus. It is of especial interest to ophthalmologists because of the frequent involvement of the eyelids in the pathologic process. It is found chiefly among laboring people, a larger proportion of cases being found in males than in females. The age incidence varies from infancy to old age. Beginning as a papule or nodule which frequently breaks down, there is formed a characteristic indolent wartlike lesion, which later presents a raised papillomatous appearance. The general health of the patient is not, as a rule, disturbed.

The condition was first described by Gilchrist,[1] in 1894, and the name "blastomycetic dermatitis," which he applied, has been used by all subsequent writers. Six months later, Busse published an account of a case of pyemia caused by a pathogenic yeast. Busche reported the same case with especial reference to the skin lesions, and it is interesting to note that a purulent destruction of the cornea is among the pathologic lesions mentioned. During the next few years, a series of reports appeared. Ricketts[2] in his exhaustive article, gave details of twelve new cases. This article is most complete from clinical history to histopathology.

In reading through the reports of most of the published cases, certainly of the earlier ones, one finds more or less obscure references to the involvement of the eyelids. Though no special references were made to this important feature of the disease, certain of the illustrations show extensive involvement of the lids and globe. For instance, in the summary of case 2 in Ricketts' series, the following appears: "The disease had extended over the left cheek to the nose, had surrounded the left orbit, and involved both upper and lower eyelids, the cicatricial tissue producing eversion of the lower lid." Also in case 3, "The region involved was recognized to be the left lower lid and the parts adjacent in both cheek and temple."

Gilchrist,[3] in an article on "Blastomycetic Dermatitis in the Negro" shows photographs of two cases which show extensive involvement of

* Submitted for publication, Jan. 21, 1930.

* Read before the International Congress of Ophthalmology Amsterdam, Sept. 11, 1929.

1. Gilchrist, T. C.: Johns Hopkins Hosp. Rep. **1**:269, 1896.
2. Ricketts, Howard: J. Med. Research **6**:377, 1901.
3. Gilchrist, T. C.: Brit. M. J. **2**:1321 (Oct. 25) 1902.

the lids. In both photographs, marked ectropion of the lower lid and extensive involvement of the skin of the lids are easily made out. To Gilchrist belongs the credit of first having observed and described this skin disease in man. The importance of blastomycosis to ophthalmologists was emphasized by Wood [4] and by Wilder [5] in 1904, and in 1915 Jackson [6] recorded two cases "of a disease hitherto supposed to be rare, and still inadequately noticed in the periodic literature and textbooks on ophthalmology," and called attention to "its clinical importance, the disastrous results through distortion of the lids, of failure to recognize it, and to its excellent prognosis under proper treatment."

A number of fatal cases have been recorded. Shepherd and Rhea [7] reported one from the Montreal General Hospital, in 1911. The disease begins, as a rule, as a sluggish red papule. If there has been a preceding traumatism, the wound does not heal or only apparent healing takes place. No part of the skin surface is immune, but the local disease seems to have a special predilection for the lids. Of nine cases reported by Pusey,[8] six showed lesions of the lower lid. Probably one fourth of the cases show diseases of these parts. Ordinarily, the primary papule becomes pustular in a short time, and the apex of the pustule becomes transformed into a crust which when removed is seen to cover an irregular, elevated, reddened base which secretes a small amount of mucopus. An early, narrow, red aureola is characteristic of the disease. Extension takes place steadily, and in from two to six months the lesion will have a diameter of from 1 to 2 inches (2.5 to 5 cm.). The rough, granular condition of the base now becomes greatly exaggerated, and gradually a coarse papillomatous or villiferous surface results, the processes of which are separated by deep irregular clefts which are filled with pus. The appearance is sometimes cauliflower-like, the verrucose tissue rising sharply above and overhanging the surrounding skin (fig. 1). In other cases, the papillomatous tissue is more flattened and shows little of the cauliflower appearance. This is always the case during the process of healing. The characteristic skin areola, red or bluish-red, rises somewhat to meet the base of the ulcer, and has an unbroken horny layer studded with numerous subepithelial or intra-epithelial abscesses. These appear as minute yellowish points. If these are pricked, they yield a droplet of sticky pus in which the organisms are easily demonstrated in large numbers. Sometimes the center loses its papillomatous surface and

4. Wood: Am. Ophth. **13**:92 (Jan.) 1904.

5. Wilder, W. H.: Blastomycosis of the Eyelid, J. A. M. A. **43**:2026 (Dec. 31) 1904.

6. Jackson, E.: Blastomycosis of the Eyelids with Report of a Case, J. A. M. A. **65**:23 (July 3) 1915.

7. Shepherd and Rhea: J. Cutan. Dis., November, 1911.

8. Pusey: J. Cutan. Dis. **21**:223, 1903.

becomes depressed below the level of the surrounding tissue, either moist red granulating or dry with cicatricial healing.

In most cases, the disease progresses rapidly with periods of comparative quiet. During the extension period of the disease, the whole surface is swollen and red, and freely secretes an offensive pus, while the areola becomes broader and more turgescent and contains a larger number of abscesses. The pus from these is decidedly bloody. During the quiet intervals the surface flattens and is dryer; the areola is narrower and flatter with fewer abscesses, which now contain little or no blood. The disposition of the disease to creep gradually from the point of origin to distant areas is well illustrated in certain cases (fig 2).

Though the rough granular condition of the base, with coarse papillomatous or villiform surfaces, the processes of which are separated by

Fig. 1.—Blastomycosis showing complete destruction of the lower lid.

deep irregular clefts filled with pus, presents a typical clinical picture, all writers emphasize the necessary differentiation from epithelioma, tuberculosis or lupus and late syphilis of the ulcerative or warty type. To these we must add sporotrichosis and the condition caused by *Coccidiodes immitis*.

The clinical history and appearance of many of the cases of blastomycosis are such as readily to indicate their character. Nevertheless, the diagnosis ultimately rests on the finding of the organism.

From a supposed lesion of blastomycosis, a diagnosis can often be made by a smear preparation from the purulent exudate of the ulcer itself or from the small superficial abscesses in the skin about the ulcer. The pus is placed on a slide, and it is often helpful to add a few drops of a tenth-normal solution of sodium hydroxide. This clears the exudate, and brings out sharply the double contour of the yeast bodies. The prepared smear is first examined with the high dry lens, when the

organisms will be seen in sharp outline as double-contoured round bodies about two to three times the size of a pus cell. The organisms in the majority of cases can be demonstrated in sections made from material obtained by biopsy. In my experience, the best results have been obtained after fixation in Zenker's solution with embedding in paraffin. The organisms stain readily with the ordinary laboratory stains, but the best one to use is Mallory's connective tissue stain. With this, the body of the organisms stains red and the periphery a deep blue. I have seen a number of cases, evidently blastomycosis, in which the organisms were demonstrated only after many examinations or not at all. Cultivation may be easily obtained on the ordinary artificial mediums, such as glycerin or dextrose agar; the best medium, however,

Fig. 2.—Blastomycosis showing the disposition of the disease to creep from point of origin to other areas.

is "Sabouraud's 4 per cent dextrose agar." At room temperature, the growth shows itself in from two to eight days, but growth may be slow, so that tubes should be kept for from two to three weeks before they are discarded as negative. The growth on agar appears as whitish colonies like *Oidium lactis* and grows as hyphae, not by the formation of yeast cells. One sometimes sees the hyphae spreading out on the surface of the test tube at the margin of the medium. On different mediums, the organisms send out mycelia with lateral buds or *Coccidia*. The most satisfactory way of studying the mycelia by staining is that recommended by L. J. Rhea: First grow the organism on a solid medium, preferably agar; then cut out a block of the agar containing a portion of the colony, fix it in Zenker's solution, embed and stain with Mallory's phosphotungstic acid hematoxylin. Excellent perma-

nent films may also be made by carefully placing the mycelium on a slide that has been covered with a thin layer of egg albumin. Before drying has thoroughly taken place, fix in Zenker's solution and then stain the fixed specimen with phosphotungstic acid hematoxylin.

The pathologic change in the skin consists in an extensive keratosis accompanied by an inflammatory reaction of the granulomatous type, with the presence of yeast cells within the giant cells or free in the tissues. One rarely sees the mycelium in man, contrary to the culture which is composed of mycelium.

The treatment for cutaneous blastomycosis consists of the administration of potassium iodide in heroic doses of from 2 to 400 grains (0.13 to 26 Gm.) a day. By this means, the lesions can be reduced if not completely cured. The use of the x-rays also causes the disappearance of the lesions, and a favorite treatment is a combination of both roentgen therapy and the administration of potassium iodide. Local abscesses are, of course, treated by the ordinary surgical principles.

LEPROSY BACILLI IN THE SCRAPING FROM THE DISEASED CORNEA IN A LEPER AND COMMENTS ON KERATITIS PUNCTATA SUPERFICIALIS LEPROSA

REPORT OF A CASE *

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It is obvious that not every disease of the eye found in a leper is caused by Hansen's bacillus. In corneal complications especially there is no agreement as to the extent to which the leprosy bacillus is the real excitor. Most authors believe that keratitis punctata superficialis, pannus leprosus and keratitis interstitialis leprosa are real manifestations of the disease, but others disagree. For instance, to quote only one example, van Driel [1] stated that it is not yet certain whether or not keratitis punctata superficialis, so often seen in lepers, is of specific origin. He was impressed by his own observation of fifteen such cases among his patients with leprosy, of whom ten were completely healed within the short time of three months, which is not usual in other ocular manifestations of leprosy.

It is, further, uncertain up to the present whether these corneal diseases when occurring in nervous (maculo-anesthetic) leprosy are due merely to a disease of the trigeminus nerve, thus placing them among the various groups of neuroparalytic keratitis, or whether they are due to nervous lesions of the lids, and should be classified as exposure keratitis. Elliot,[2] in his book on "Tropical Ophthalmology," expressed the belief that "the troubles met with in the nerve type are mainly the secondary results of exposure of the eye." Rogers and Muir,[3] in their monograph on leprosy, in connection with pannus leprosus and other specific forms, stated that "when the disease is of the most superficial subtype, a ground-glass like appearance, resembling pannus, is noticed gradually increasing inwards from the corneal margin, most frequent in the upper sector. This lesion, which is caused by infiltration of the

* Submitted for publication, Dec. 7, 1929.

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1. Van Driel, B. M.: Die Ergebnisse einer Augenuntersuchung bei 350 Leprakranken, Nederl. Tijdschr. v. Geneesk. **1**:770, 1922.

2. Elliot: Tropical Ophthalmology, London, Oxford University Press, 1920, p. 438.

3. Rogers, L., and Muir, E.: Leprosy, New York, William Wood & Company, 1925.

cornea, is probably not accompanied by the actual presence of bacilli in the cornea." There is also much discussion in the literature as to which contains more bacilli in its lepromas—tuberous or nervous leprosy. The same authors summarized their opinion in the sentence: "Nerve lesions are associated with a comparative paucity of the number of bacilli present in the body." [4]

There is only one way to decide this question, which is as important from the scientific as from the practical standpoint, and that is to show the presence of leprosy bacilli in the complications in question. Their presence can be postulated since it is well known that leprosy bacilli are as a rule present in numbers in histologic sections of the manifestations of the disease in all parts of the body. As it is not usually possible to prove the presence of the bacilli in histologic specimens, I recommend strongly the extensive use of the simple method of scraping the epithelium of the cornea and conjunctiva. The case to be reported shows how simple and effective this method is. The purpose of this paper is to stimulate the use of this method on a larger scale than is possible with the few cases seen in northern China inside the Great Wall.

It is probable that this method of epithelium scraping, which has already proved its efficiency in the mucous membrane of the nose, will prove efficient also in the mucous membrane of the mouth and throat and even on the skin, as shown by my own case.

The technic is that originated by Linder [5] and used in cases of acute infectious diseases of the conjunctiva and cornea by modern ophthalmologists: Four per cent cocaine and epinephrine is instilled three times into the conjunctival sac at intervals of from one to two minutes, after which the epithelium is scraped off without danger with a platinum spatula. The eye is then bandaged for half an hour. The material is spread on a cover-glass, and after drying is fixed in the flame or in 95 per cent alcohol for two minutes; it is then stained according to the Ziehl-Nelsen method for tubercle bacilli.

It is of great importance to make the scrapings in different parts of the diseased area, as the bacilli may not be present anywhere. It is also necessary to make several scrapings in case the first specimens prove negative. Since it is probable that the most recent manifestations of the disease will contain more bacilli than others that are clinically already in the stage of healing, an exact clinical examination with the slit-lamp, if possible, should precede the bacteriologic examination to ascertain the most recent pathologic changes.

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4. Rogers and Muir (footnote 3, p. 182).

5. Lindner, K.: Ueber die Topographie der parasitären Bindehautkeime, Arch. f. Ophth. **105**:726, 1921.

The value of the examination of epithelium scraped from the living eye is shown in the following case of a patient with nervous leprosy with eye complications seen in the ninth year after the onset.

REPORT OF CASE

History.—L. H. C., a man, aged 28, had had leprosy for eight or nine years. It began with numbness of the arms and legs, which for a long time was the only symptom. He had been examined in the Peiping Union Medical College Hospital several times in the past years, and the record showed that he had a case of neuroleprosy. The patient never showed symptoms of the tuberous form.

For three days before coming to the clinic on March 24, 1929, he noticed blurring of vision in the left eye without pain, for which he asked for glasses. His right eye, he claimed, was normal. He had never had trouble with his eyes before and had always had excellent vision.

The hairs of the eyebrows had fallen out little by little five years before; the cilia, somewhat later.

Examination.—On March 24, examination showed that the hairs of the eyebrows and of the margins of the lid were entirely absent. There were no scars in the skin of these regions, showing that the falling out of the hairs was not due to the inflammatory changes so often recorded in other cases of leprosy, especially in the tuberous form. The outer and inner edges of the intermarginal strip of the lids were indistinct. The skin of the lids as well as of the entire face was thickened and folded. Although the patient could open his lids normally, after a short time both upper lids became ptotic from weakness of the upper levator palpebrae.

The conjunctiva of the lids and the plica semilunaris were extremely pale, but the structure of the blood vessels was just visible all over the conjunctiva. The tear production was normal, but on account of the complete anesthesia of the entire conjunctiva there was no reflex epiphora after irritation of the conjunctiva or the cornea.

The right eyeball was pale, but somewhat pigmented near the limbus. The left eyeball showed a moderately uniform mixed injection.

The right cornea had a normal surface and luster and was transparent to the naked eye. Focal illumination in the dark room, however, showed many fine, somewhat line-shaped opacities, which the loupe proved to be built up of pinpoint-shaped, grayish-white nodules, lying near the surface of the cornea with a normal epithelium, not elevated and not ulcerated, in front of them. This is the picture of a keratitis punctata superficialis in the early stage (fig. 1 *A*). The single spots were more or less regularly distributed over the upper half of the cornea, a little more numerous toward the otherwise normal limbus. There were no blood vessels growing into the cornea. The single opacities extended downward on both sides of the cornea, but more on the temporal side, leaving the normal cornea between. In the upper third, the cornea between the single spots appeared a little cloudy and gray, but the contrast with the smallest white nodules was everywhere distinct. The lower half of the cornea showed three isolated pinpoint-shaped spots about 2 mm. distant from the limbus, near 5 o'clock.

The left cornea showed the same keratitis punctata superficialis in the upper third, without the extension downward, but rather sharply defined horizontally. The whole cornea was somewhat hazy, due to edema of the cornea caused by the iridocyclitis in this eye.

In both corneas sensibility to the touch, with a stiff hair or a thread of cotton, was entirely absent, and even a touch with the finger did not produce the normal lid closure reflex. The entire bulbus and the conjunctiva of the lid were anesthetic in the same way, as was the skin of the face in the region of all three branches of the trigeminus nerve. Closure of the lid was normal, and there was not the slightest trace of exposure keratitis or any irregularity of the epithelium in the region of the palpebral fissure.

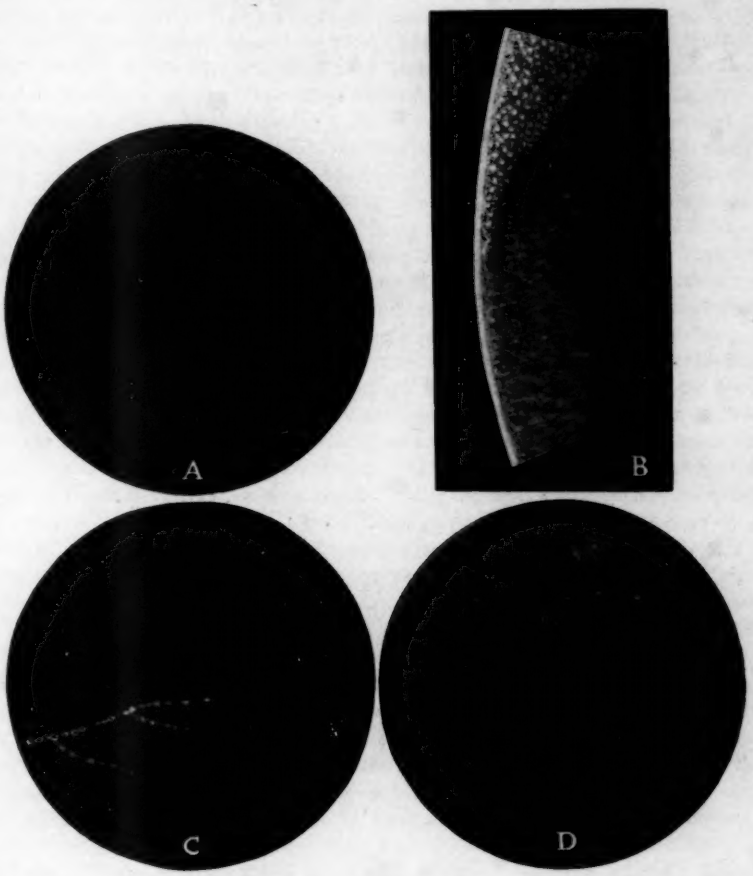

Fig. 1.—*A*, keratitis punctata superficialis leprosa of the right eye. Notice the three isolated spots in the lower half of the cornea. *B*, a narrow optical section (slit-lamp ocular 2, objective *a* 2) through the diseased upper part of the left cornea; the spot-shaped infiltrations of the keratitis punctata reach Descemet's membrane near the upper limbus. The corneal disease occupies a cuneiform zone, going from Bowman's to Descemet's membrane. *C*, one corneal nerve, seen with the slit-lamp in the right eye at 8 o'clock, in an area which was not involved clinically (see *A*). Small and large nodules formed a rosarium even on the finest branches. *D*, keratitis punctata leprosa and pannus leprosus near the upper limbus of the left eye.

The observations with the slit-lamp were interesting. The epithelium of the cornea as a whole was normal and plain. By examination with the narrow slit, however, the epithelium line could be seen to be somewhat wavy over some of the white nodules near the upper limbus, and the nearer one came to the limbus the greater was the separation of the "epithelium line" from the corneal parenchyma by a black space, which was the expression of the edema in the epithelium and of the changes of Bowman's membrane. Near the upper limbus the epithelium line itself was slightly thickened. In the lower half of the cornea, many exfoliated epithelial cells were sometimes visible, especially in indirect illumination, as light brownish points. On account of the anesthesia of the cornea, much dust was suspended in the capillary layer of tear fluid.

The parenchyma of the cornea showed equal thickness all over, but the inner reflexion was increased in the region of the keratitis punctata by two causes: (1) the nodules themselves and (2) edema and a slight degree of infiltration, increasing gradually in intensity from the lower boundary of the nodules, where it was found superficially, to the limbus, where it occupied the entire parenchyma up to Descemet's membrane (fig. 1 *B*).

The nodules themselves, localized with the narrow beam, were almost all lying at the same level behind Bowman's membrane. They were of about the same size and were irregular in shape, dentated at the margin and consisted of many minute fine dots. They showed no tendency to confluence. Near the upper limbus the nodules were lying also in the deeper layers of the parenchyma, giving to the naked eye a more uniform color of the cornea, like a pannus.

With the slit-lamp the cornea between the nodules showed a more or less gray color. Sometimes there was a very delicate, irregular, superficial network, the fibers of which were indistinct and disappeared gradually. The whole superficial parenchyma, seen with 68 times magnification, showed a definite dotted structure, some of the dots forming small groups.

The posterior surface of the right cornea was normal. Neither the slightest bedewing nor pigmentation was visible, not even in the upper third, which is the zone of superficial keratitis. The left Descemet's membrane, due to the iridocylitis, was full of bedewing, more so in the lower than in the upper portion.

The nerves of the cornea were severely altered. Most of them were indistinct compared with those of a normal cornea. Some were thicker than usual, and in each eye could be seen nerves almost symmetrically situated at 8 and 4 o'clock, respectively, which showed definite nodules in their course (fig. 1 *C*). These nodules were at irregular distances and often attained the size of double the diameter of the nerve. The branching points seemed the preferred location. These thickened nerves were visible even in indirect illumination of the slit-lamp and resembled closely the glass stripes seen in cases of grill-like or nodular keratitis (Haab-Dimmer), which I mentioned in an earlier paper.[6] Curiously enough, no nerves were visible in the zone of the keratitis punctata superficialis.

The anterior chamber, iris and lens of the right eye were normal. The anterior chamber of the left eye was filled with a fluid rich in protein (Tyndall phenomenon), in which a fibrinous network and some floating white opacities were visible. The left iris was uniformly swollen and was darker than the right, but there were no nodules. After the administration of atropine, a few posterior synechiae became visible in the lower half.

Bacteriologic Examination.—On March 25, a scraping from the diseased upper half of the left cornea was made. Leprosy bacilli were found in about twenty-five

6. Pillat, Arnold: Ueber die gittrige und andere Formen degenerativer Hornhauterkrankungen, Ztschr. f. Augenh. **49**:313, 1922.

epithelial cells. In some of the cells one or two bacilli were seen, while a few cells were filled with bacilli, often in the typical position, lying parallel to each other and crossed by one or two. In some of the epithelial cells, small red granules were found which were bacilli broken up into small particles. The leprosy bacilli were usually found in cells lying single which were easily separated from the other cells by scraping, but a few bacilli were also seen in the epithelium plaques. The epithelial cells, loaded with bacilli, usually showed a smaller nucleus with an irregular chromatin structure. The protoplasm was often dotted by staining, and showed vacuoles. The bacilli were frequently found in one corner of the protoplasm. A few leprosy bacilli were found outside the cells.

On March 26, the same observations were obtained from another scraping of the left cornea. Scraping from the skin of the temple and the lower lid showed many leprosy bacilli, as well as free bacilli, in the epithelial cells.

On March 27, a topographic examination of the cornea, bulbus and epithelium of the lid was made: In the upper half of the cornea, the same observations were found as on the two previous days. In the lower half of the cornea, some plaques of epithelium were obtained by scraping. A few leprosy bacilli and two epithelial cells were found. One bacillus was found on each of two other cells. The total number of the epithelial cells was approximately 100.

The upper and lower parts of the bulbus and the temporal and nasal bulbus showed only epithelium plaques; there were no bacilli.

The upper and lower lids showed only epithelium plaques; there were no bacilli.

On March 29, the examination of the lids was repeated. No bacilli were found on the upper lid. In approximately ten places on the lower lid, a few leprosy bacilli were found, mostly in the enlarged intercellular spaces or in hollows in the protoplasm of the epithelial cells. At one place many bacilli were seen, many of them broken into granules.

On April 10, sixteen days after the patient's admission to the hospital, the keratitis punctata superficialis of the right eye was in the stage of healing, the single white dots having become blurred in outline and seeming to disappear by gradual absorption.

The left eye had changed considerably. The keratitis punctata superficialis had almost disappeared, and in the upper half the cornea showed a homogeneous pannus-like appearance without blood vessels (fig. 1 *D*). A few days later, with the slit-lamp the infiltration could be followed to the deepest layers of the parenchyma near the upper limbus, thus proving this to be a real interstitial keratitis.

During the course of four more weeks, the corneal disease as well as the iritis of the left eye healed clinically through the application of radium, atropine and heat.

Although keratitis punctata superficialis has been known of almost as long as the leprosy bacillus discovered by Hansen, described by Hansen and Bull [7] in 1873, and mentioned by Uhlenhut [8] and Borthen,[9]

7. Hansen and Bull: The Leprous Disease of the Eye, Chrisitania, 1873.

8. Uhlenhut: Ein Fall von lepra tuberosa mit besonderer Berücksichtigung einer beginnenden leprösen Hornhauterkrankungen (keratitis punctata superficialis), Charité Ann. **23**:810; quoted by Meller.

9. Borthen: Die Lepra des Auges, Leipzig, Wilhelm Engelmann, 1899.

and although anatomic examinations were made by Jeanselme and Morax [10] 1898, and by Meller [11] 1905, there are still some points under discussion.

Is keratitis punctata superficialis a complication found more frequently in the tuberous or in the nervous (maculo-anesthetic) form of leprosy? There seems to be no doubt that complications of the eyes as a whole are more frequently encountered in the tuberous form, but there is no uniform opinion as to the extent to which corneal complications especially are found in the tuberous and in the nervous forms. In regard to keratitis punctata superficialis, the opinion first given by Borthen [9] still seems to prevail, namely, that this type of keratitis is seen especially in the tuberous form (see the cases of Hansen and Bull,[7] Uhlenhut,[8] Borthen,[9] Jeanselme,[10] and Meller,[11] and more recent cases, as those of Levitt [12] [1922], Peter [13] [1924], Knapp [14] [1925], Naar [15] [1927] and others). Other authors, as Pfingst,[16] expressed the opinion that complications of the eyes are encountered as often in patients with nervous leprosy as in those with the tuberous type. Wood [17] expressed the belief that complications of the eyes are found in every leper who lives long enough for them to develop. Gyotoku,[18] discussing the cases of 300 lepers, found the following distribution of complications in the eyes: in the nodular form, 76 per cent; in the nervous form, 74 per cent, and in the macular form, 30 per cent. This means that corneal complications are encountered equally in both main types of leprosy. In my case, the keratitis punctata superficialis was a complication of the typical nervous form. This discrepancy in opinion may find its solution in the future through the study of all cases of leprosy with the slit-lamp, since keratitis punctata superficialis may easily be overlooked. In Peter's [3] case, the disease could be detected only with the slit-lamp.

There is no clear and uniform conception whether keratitis punctata superficialis is a disease definitely defined or whether its picture is

10. Jeanselme and Morax: Des manifestations oculaires de la lépre, Ann. d'ocul., vol. 120, p. 321.

11. Meller, J.: Ueber die Keratitis punctata leprosa, Klin. Monatsbl. f. Augenh. **1**:71, 1905.

12. Levitt, M.: A Case of Leprous Keratitis Punctata, New York M. J. **116**: 376, 1922.

13. Peter, L.: Nodular Iritis Due to the Bacilli of Hansen (Leprosy); Slit-Lamp Studies, Arch. Ophth. **53**:258, 1924.

14. Knapp, P.: Sur un case de lépre oculaire, Rev. gén. d'opht. **39**:275, 1925.

15. Naar, C. W.: Augenveränderungen bei Lepra, Nederl. Tijdschr. v. Geneesk. **2**:2302, 1927.

16. Pfingst, A. O.: Ocular Complications of Leprosy, Am. J. Ophth. **9**:195, 1926.

17. Wood, D. S.: Ocular Leprosy, Brit. J. Ophth. **9**:1, 1925.

18. Gyotoku, K.: Beitrag zur Kenntnis der klinischen und histologischen Befunde am leprösen Auge, Ztschr. f. Augenh. **63**:254, 1927.

closely connected with pannus leprosus and with interstitial leprous keratitis, in the sense that one type may change into another (Tisconia [19]). Some observations in the literature seem to point to the latter opinion. My case, in which in the right eye the typical keratitis punctata superficialis persisted as such and disappeared by absorption, is of great interest. In the left eye, on the contrary, the keratitis punctata superficialis changed first into a uniform superficial pannus and later, while the patient was under observation in the hospital, into an interstitial keratitis. This indicates that a few leprosy bacilli in the cornea may produce miniature lepromas seen clinically as keratitis punctata superficialis. The bacilli may become destroyed, and the spot-shaped infiltrates may be absorbed. When, on the other hand, the number of bacilli is larger, the superficial infiltrates may flow together (pannus leprosus) and may even go into the depth of the cornea (interstitial leprous keratitis).

There is insufficient knowledge of the relation between keratitis punctata superficialis and iritis, so often found together in the same eye. The superficial keratitis often appears before the iritis (Bhaduri [20]), but sometimes it follows the iridocyclitis. In most of the cases recorded in the literature, mention is made of the presence of both complications but nothing is said of the order of occurrence. The difficulty lies in the fact that in most cases the presence of a keratitis punctata superficialis is not noticed by the patient, since, on account of its peripheral location, it causes neither pain nor blurring of vision. In my case definite judgment is not possible because the patient came to the clinic the moment he noticed the blurring of vision of the left eye due to iritis. Judging, however, from the well established keratitis punctata superficialis in both eyes, it may be correct to say that the keratitis punctata preceded the iritis.

It is certain that keratitis punctata superficialis may exist without iritis, as is shown by the right eye of my patient. The fact observed by Levitt,[12] in a man, aged 37, that a keratitis punctata superficialis may recur repeatedly, is interesting.

It is interesting that in my case of keratitis punctata superficialis the presence of leprosy bacilli could be shown so easily by means of scraping the corneal epithelium.

In spite of the fact that many authors found leprosy bacilli in a great percentage of cases in the secretion or in the scrapings from the nose, only a few authors have examined the discharge of the conjunctival sac in lepers. "Morax, in 6 lepers with ocular lesions, found a very

19. Tisconia, A.: Augenkomplikationen bei Lepra, Arch. de oftal. de Buenos Aires **2**:321, 1927.

20. Bhaduri, B.: Iridocyclitis in Leprosy, Indian M. Rec. **46**:269, 1926.

few bacilli in the conjunctival secretion of only one case; Auche found them twice in 25 examinations, both cases having ulcerated lesions" (Rogers and Muir [21]). Hollmann found leprosy bacilli in the tears of two lepers with lesions of the sclerotic. According to his statement, acid-fast bacilli were found in 14.2 per cent of nodular leprosy; altogether 205 specimens of the lacrimal secretions of 41 lepers were stained. Van Driel [1] mentioned seeing conjunctivitis in acute exacerbations of various manifestations of leprosy, but there were no bacilli in the secretion. Neame [22] examined a case of lepra nodosa affecting the conjunctiva in the form of nodules and the cornea in the form of what was probably keratitis punctata superficialis. He found many leprosy bacilli in a scraping from the mucous membrane of the nose and many bacilli in the subconjunctival tissue of an excised limbus nodule. Fernandez [23] mentioned that in case of decay of diseased ocular tissue in lepers many bacilli may appear in the discharge from the conjunctiva (only reference to the paper by Lauber was available to me).

Axenfeld [24] and Meller [11] mentioned that leprosy bacilli may be found in keratitis punctata leprosa lying in groups under Bowman's membrane. They found the bacilli in cuts from the superficial layers of the cornea made with the keratome. Naar [15] was the first to make epithelial scrapings from the cornea. In 1927, he did this in four cases of tuberous leprosy. In the first case, one of both superficial and deep keratitis punctata, he found many bacilli in the secretion from the nose and mouth and a few bacilli in the secretion from the conjunctiva, but no bacilli in the scraping from the cornea. In the second case, that of a patient with pannus leprosus and atrophy of the iris, and in two other cases that are briefly reported, he found leprosy bacilli in the epithelial cells of the cornea. There is no reason why these bacilli should not be found also in other cases of keratitis punctata superficialis and of pannus leprosus. Pinkerton,[25] discussing keratitis punctata, stated: "I have taken numerous scrapings from the cornea where these leucomatous spots are most frequent and in a few cases I have found the bacillus lepra." Examination on a larger scale will probably give more evidence

21. Rogers and Muir (footnote 3, p. 164).

22. Neame, H.: Case of Leprosy Affecting the Conjunctiva and Cornea, Proc. Roy. Soc. Med. (Sect. Ophth.) **14**:16, 1921.

23. Fernandez, F. M.: Ueber die Augenkomplikationen der Lepra, Arch. de oftal. hispano-am. **26**:301, 1926.

24. Axenfeld, T.: Die Bakteriologie in der Augenheilkunde, Jena, Gustav Fischer, 1907.

25. Pinkerton, F. J.: Leprosy of the Eye: An Analysis of the Records of 512 Cases of Leprosy in the Hawaiian Islands, Arch. Ophth. **56**:42, 1927.

It will be possible in the future, by systematic scraping of the cornea, not only to differentiate accidental corneal diseases from manifestations of real leprosy, but also to follow the course of infection in the eye, to watch the increase and decrease of the local infection and to get a deeper insight into the mode of infection.

From this point of view, it is interesting to note the three sites at which leprosy bacilli were found in my case (fig. 2). Besides the diseased upper part of the cornea, the lower half also showed bacilli, although on the surface it was normal both clinically and on examination with the slit-lamp. Bacilli were found also on the normal conjunctiva of the lower lid, whereas the conjunctivae of the upper lid and of the eyeball were free from leprosy bacilli. In addition, leprosy bacilli were

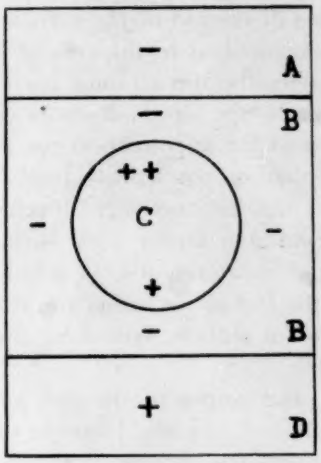

Fig. 2.—*A* indicates the upper lid; *B*, the bulbus; *C*, the cornea, and *D*, the lower lid.

found in the diseased skin over the temple and near the margin of the lower lid. I cannot explain why bacilli were not found on the bulbar conjunctiva, which had the same type of squamous epithelium as the cornea and the skin, but one should not pay too much attention to this negative observation as the scraping was done only twice and not all the parts of the conjunctiva of the eyeball were examined. The observation of leprosy bacilli on normal parts of the eye by the method of epithelium scraping is in accordance with previous anatomic observations in sections from the whole eyeball reported on years ago by Axenfeld [24] and more recently by Suganuma and Hojo,[26] who examined

26. Suganuma, S., and Hojo, M.: Histologische Untersuchungen über Keratitis punctata superficialis leprosa nebst Bemerkungen über Hornhautentzündung, Arch. f. Augenh. **77**:227, 1914.

a case of keratitis punctata superficialis histologically and found many leprosy bacilli not only in the infiltrates corresponding to the white spots, but also within the lamellae in the areas clinically normal, especially where small nerves perforated Bowman's membrane. Gyotoku [18] anatomically examined four bulbi lepers, who did not show a trace of disease. In these four eyes, he found cellular infiltrates with many leprosy bacilli in the region of the chamber angle. He stated that in leprosy the infection in the eye proceeds from the exterior to the interior part and not as a rule in the opposite direction. My case seems to support this theory. It is probable that the bacilli were brought from the diseased skin directly to the conjunctiva of the lid and from there to the cornea by contact or via the bulbar conjunctiva, although in my case the latter was free from bacilli. It is doubtful if this is the way of transmission in all cases of disease of the cornea, but it is at least one way. In the future, examination of the area around the capillaries of the limbus by means of epithelium scraping may show whether or not the way of transmission by the blood vessels in certain conditions, like episcleritis and leproma of the sclerocorneal junction, is of importance.

It is uncertain whether or not leprosy bacilli can enter the retina and choroid by way of the conjunctiva. Mancione [27] examined histologically specimens from five lepers with corneal infiltration, iritis, secondary glaucoma and chorioretinitis, in which he claimed to have found many bacilli in the foci in the retina and choroid, a fact contrary to the observations of most authors, who have always found the retina free from leprosy bacilli.

From the positive observations of the skin and the surface of the eye, in which the bacilli were so easily found in the epithelium layer, it is evident that the transmission of leprosy to other parts of the body and to other persons is easily possible.

SUMMARY

A case of keratitis punctata superficialis is reported in a patient with nervous leprosy of eight years' duration. It is shown that the keratitis punctata superficialis may exist alone (right eye) or that it may change into a superficial leprous pannus and later into an interstitial keratitis (left eye).

Leprosy bacilli were found in the corneal epithelium of the diseased area, which was scraped off with a platinum spatula.

Leprosy bacilli were also found by scraping off the epithelial cells of the diseased skin next to the eye.

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27. Mancione, L.: Contributo clinico anatomica et terapentico allo studio 'ella lepra oculare, Arch. di oftal. **28**:247, 1921.

Leprosy bacilli were found in two places in the eye, the lower half of the cornea and the conjunctiva of the lower lid, although they were normal clinically.

Scraping off the corneal and conjunctival epithelium is strongly advocated as a routine measure in all cases of leprosy of the eye in order to differentiate real conjunctival and corneal manifestations of leprosy of the eye from accidental diseases and to get clear evidence of the mode of infection.

RECIPROCAL INNERVATION OF THE EXTRA-OCULAR MUSCLES *

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When one voluntarily flexes the arm at the elbow, two things occur: first, there is sent to the biceps muscle an excitatory impulse from the motor cortex; second, there is sent simultaneously to the triceps muscle an inhibitory impulse. This association of an excitatory stimulus to a muscle or group of muscles with a simultaneous inhibitory stimulus to the antagonistic muscle or group was first discovered by Sherrington in 1893.[1] He found that in the case of the flexors and extensors of the limbs excitation of one group was always accompanied by relaxation of the other, and the occurence of this phenomenon was sufficiently widespread to warrant the annunciation of a law, which he called the law of reciprocal innervation. This states that during active contraction of a muscle there occurs a simultaneous relaxation in its antagonist. "As contraction progresses in a muscle, for example an extensor, contractile activity diminishes pari passu in the antagonistic flexor." (Fulton.[2])

In 1893, Sherrington [3] performed an experiment which proved that this law also held good in the case of the extra-ocular muscles. The experiment was as follows: The third and fourth nerves were cut intracranially on one side of a monkey; for example, on the right side. After several weeks had elapsed for complete degeneration of the cut nerves to take place, examination of the animal showed a complete paralysis of all of the extra-ocular muscles on the right side save the external rectus muscle, innervated by the sixth nerve. The right eyeball was abducted, therefore, in the position of rest due to the tone of the external rectus unopposed by any tone of the antagonists. The only voluntary motion possible in the eye was further abduction. When, however, Sherrington placed electrodes on the cerebral cortex in the region known to elicit conjugate deviation of the two eyes to the left, he

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* From the Department of Physiology and Ophthalmology, University of Pennsylvania.

* Read at a Meeting of the Academy of Ophthalmology and Otolaryngology, Atlantic City, N. J., Oct. 24, 1929.

1. Sherrington, C. S.: Note on the Knee-Jerk and the Correlation of Action of Antagonistic Muscles, Proc. Roy. Soc. Med. **52**:556, 1893.

2. Fulton: Muscular Contraction and the Reflex Control of Movement, Baltimore, Williams & Williams Company, 1926, p. 447.

3. Sherrington, C. S.: Further Experimental Notes on the Correlation of Action of Antagonistic Musles, Proc. Roy. Soc. Med. **53**:407, 1893.

found that not only did the left eye turn sharply to the left owing to the pull of the external rectus muscle of this side, but the right eyeball also moved slightly from its position of abduction in toward the midline. Since all the muscles on the right side were paralyzed save the right external rectus, the movement of this eye inward could be due only to a relaxation of the tone of this muscle, and this diminution of tone in the right external rectus in connection with an increase in tonic activity of the opposite antagonistic external rectus constitutes reciprocal innervation.

The presence of reciprocal innervation in flexors and extensors of the limbs has been demonstrated many times, clinically as well as in the laboratory, but so far as I am aware, satisfactory evidence has not been presented which demonstrates reciprocal innervation in the ocular muscles of human beings. In fact, some authors deny that it exists. Wilbrand and Saenger,[4] in speaking of lateral movements of the eyes, inferred that it occurs in the external ocular muscles. They said:

> In looking straight ahead on a definite distant object all the eye muscles are under slight tension (tonic innervation). When an impulse is sent to the right turners the tension of these muscles is increased while the tonus of the left turners is diminished (Sherrington).

Further on, in speaking of divergence of the eyes, is the following passage:

> The impulse for relative divergence, i. e., for diminution of convergence, goes to both internal recti muscles. The relaxation of both the interni does not occur passively by a contraction of the external recti causing a stretching in the muscles but really as a positive inhibition which even is effective when the contraction of the antagonistic muscles cannot occur, for example, in peripheral paralysis (Sherrington and Topolansky).

Tilney and Pike,[5] in 1925, objected to the interpretation of Sherrington's experiments on the grounds that "by sectioning the oculo-motor nerve the paralysis of the internal rectus muscle, as well as the position of the eye in consequence of this paralysis, introduces a pathologic element into the experiment. The unopposed action of the external rectus causes a hypertonic retraction in the muscle." They pointed out that the only valid solution of the problem would come as the result of investigating the tension changes in the eye muscles directly. The experiments of deKleyn,[6] however, leave little room for doubt as to the existence of reciprocal innervation in the extra-ocular muscles of rabbits.

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4. Wilbrand and Saenger: Neurologie des Auges, Munich, J. F. Bergmann, 1922, vol. 8, p. 16.

5. Tilney and Pike: Muscular Coordination Experimentally Studied in Its Relation to the Cerebellum, Arch. Neurol. & Psychiat. **13**:289 (March) 1925.

6. deKleyn: Ueber vestibular Augenreflexe, Arch. f. Ophth. **107**:480, 1922.

He studied the behavior of the ocular muscles during artificially induced nystagmus. After removing the eyeball in the decerebrate rabbit and connecting the internal and external recti muscles directly to accurate recording levers, deKleyn produced nystagmus by irrigating one or the other of the two labyrinths with cold water. His records show well that when the ipsolateral labyrinth is irrigated, a lateral nystagmus results in which the external rectus muscle contracts slowly and at the same time the internal rectus muscle relaxes correspondingly until the muscles reach the full extent of their movement, at which point the internal rectus contracts suddenly and the external rectus relaxes with corresponding rapidity.

In their paper, Tilney and Pike stated that an appeal to clinical experience in the field of oculo-motor paralyses should furnish abundant evidence in substantiation of Sherrington's experiment. They stated, however, that one of them has never observed any inward movement in eyeballs in which there is a complete lesion of the third and fourth cranial nerve nuclei. They sent the following question to twelve eminent ophthalmologists, asking for an opinion:

> In a case of complete left unilateral oculo-motor and trochlear paralysis producing divergent strabismus to the left is there any movement of the eyeball when the patient's gaze is directed toward the right?

With one exception, the replies to this questionnaire were in the negative.

The following cases are presented as evidence that reciprocal innervation does occur in the extra-ocular muscles of man, and that it can be seen clinically, if looked for, in cases of paralysis of the ocular muscles. The existence of this physiologic phenomenon is to be expected in the eye muscles on the grounds of efficiency of action, and were it not for the fact that its occurrence has been doubted by several authors, it would appear unnecessary to lay stress on the subject.

REPORT OF CASES

CASE 1.[7]—*History.*—On Feb. 2, 1929, M. N., aged 47, presented herself at the Wills Hospital in the service of Dr. Baer, showing a complete bilateral paralysis of the internal and external third nerve on both sides and, as far as could be determined, a complete paralysis of the fourth nerve on both sides.

Five weeks before entering the hospital, while working around the kitchen, she suddenly felt sharp pains in the back of her neck followed by immediate loss of vision and in a few moments by unconsciousness. She was taken to a hospital and was unconscious until that evening. After regaining consciousness there was no paralysis of other parts of the body save the ocular muscles. She spent two

7. Dr. B. F. Baer and I presented this case at the Section on Ophthalmology of the College of Physicians of Philadelphia, April 19, 1929.

weeks in the hospital and on discharge her condition, as far as the paralyses were concerned, was about the same as it was on admission. Her distant vision, however, recovered completely as far as she could tell. Her past history was of no significance save for several attacks of migraine and occasional severe headaches accompanied by vomiting. Eight years before the present illness she had a menopause, and since then the headaches had been less frequent.

Physical Examination.—Examination showed a rather thin, slightly built woman. There was a complete paralysis of the third and fourth nerves on both sides resulting in ptosis, immobility of the eyeballs save for abduction, dilated inactive pupils and paralysis of accommodation. None of the other cranial nerves were affected. Her vision was 6/9 for the right and 6/12 for the left eye.

Ophthalmoscopic examination of the right eye showed the media to be clear. The disk was oval, axis 15, of good color and well outlined except for a sclerae crescent with an area of choroidal pigment disturbance adjacent. There was a general uncovering of the choroidal circulation throughout. The blood vessels were normal. No discrete lesions were seen.

The left eye showed the media to be clear. The disk was oval, axis 90, of good color and well outlined. No lesions were seen. The blood vessels were normal. The form fields were normal for 3/360 white and 5/360 red and blue.

Examination of the chest revealed a chronic myocarditis with auricular fibrillation and mitral stenosis. The blood pressure was 116 systolic and 86 diastolic. Only two front teeth remained and the gums showed slight pyorrhea.

Examination of the nose and throat showed definite pus in the sphenoethmoidal fissure on the left side. A diagnosis was made of a bilateral sphenoiditis, and operation was advised. This was carried out under local anesthesia, and the mucous membrane of the sphenoid sinus on the left side was found to be acutely inflamed. The posterior ethmoidal cells on the same side were opened, but no pus was seen. A few days later the right sphenoid and posterior ethmoids were opened, and the same condition was found but not so severe as on the left side. Roentgenograms of the skull and sinuses showed evidence of bilateral ethmoid and sphenoid involvement but no other changes in the skull.

Neurologic examination in Dr. Weisenberg's clinic showed no neurologic signs other than the complete paralysis of the third and fourth cranial nerves. It was believed that the lesion was probably a hemorrhage.

The Wassermann, Kolmer and Kahn tests of the blood were negative. All these tests were carried out in view of the fact that Uhthoff[8] had insisted so strongly that bilateral oculomotor paralyses are nearly always due to syphilis. The patient later said that an examination of the spinal fluid had been made for the same purpose at the hospital in which she was first taken, and that the results were negative. An electrocardiogram revealed an auricular fibrillation with marked left ventricular preponderance. Examination of the urine gave negative results.

Treatment and Course.—The patient was given mercury rubs daily and iodides. She left the clinic approximately three weeks after her admission, and showed slight beginning recovery, judged by the degree of ptosis. There seemed to be more power in both the right and the left upper lid.

8. Uhthoff, quoted by Wilbrand and Saenger (footnote 4, p. 417).

During her stay in the hospital, this patient showed the following phenomena:

1. Immediately on elevating the upper lids the eyes were in a divergent position, approximating a 30 degree squint. This was the position of rest, probably occasioned by the unopposed tonus of each external rectus muscle.

2. If one lid only were raised, that eye which was divergent could be seen occasionally making a slight inward rotation. This rotation never carried the eye to the midline, and no further movement of the eye inward could be elicited voluntarily. It could be seen that this rotation toward the midline occurred only when the opposite eye was strongly abducted.

3. With both lids elevated, the patient could rotate either eye from the position of rest outward, showing definite power in each external rectus. When she was asked to look to the right, the right eye was further abducted and the left simultaneously moved from its abducted position in toward the midline. This was also true of the left eye when the patient was requested to look strongly to the left. At no time was the inward motion of either eye as for as the midline.

The explanation of these phenomena is believed to be as follows:

1. With both eyes closed, the eyeballs seek their position of rest, which is fairly wide divergence due to the normal tonus of both external recti increased perhaps by beginning contracture of each muscle, which is known to follow the paralysis of an antagonistic muscle.

The movement inward of the left eye from the position of rest when the patient looked far to the right is due to a relaxation of the tonus in the left external rectus accompanying the contraction of the right external rectus. There is, therefore, a reciprocal innervation of the left external rectus with the right external rectus as demonstrated experimentally by Sherrington and others.

The same explanation holds for the right external rectus when the patient looks far to the left. The only objection which might be raised to this explanation is that the internal rectus of each eye might not be completely paralyzed and that the motion of each eye inward was due to some slight action on the part of the internal recti. In Sherrington's experiments, the third nerve was cut inside the skull, and therefore there could be no doubt of a complete paralysis of the internal rectus. One can judge clinically of a complete nerve paralysis only by the lack of motion in the eye, and in this case there was no complete proof that the third nerve was totally paralyzed. If, however, there were action in the internal rectus, no matter how slight, it would seem obvious that the eye would be rotated beyond the midline, and this, as I have stated, did not occur.

In order to rule out positively any possible action on the part of the internal recti, 1 cc. of a 2 per cent solution of procaine hydrochloride was injected into and along the right internal rectus muscle, and after sufficient time had elapsed for complete paralysis of this muscle to take place (if it were not already paralyzed), an examination of the ocular movements was again made. The right eye still moved in toward the midline from the position of rest as before when the patient looked to the left. This proves that the movement inward could not have been due to any remaining power in the internal rectus muscle.

Although no downward movement of either eye could be elicited, a positive diagnosis of a complete paralysis of the fourth nerve was scarcely justified, since the action of the superior oblique as a downward rotator is hardly apparent save when the eyeball is in the adducted position. This being impossible in the presence of a paralysis of the third nerve, it was felt that caution should be used in making a positive diagnosis. As concerns the present problem, however, it would make no difference whether or not the fourth nerves were paralyzed, since the superior oblique is an abductor and not an adductor, and hence could not be held responsible in any way for the inward movement of the eye.

CASE 2.—*History.*—A. J., a man, aged 23, was referred for examination by Dr. Charles A. Rankin, to whom I am indebted for the following clinical notes. He had noticed double vision, dizziness and nausea on April 7, 1929. He first consulted Dr. Rankin on April 27, 1929, having had two weeks of osteopathic treatment. Examination at that time showed the right eye to be normal. There was a complete ptosis of the left upper lid and loss of all movement of the left eyeball save for abduction. The pupil was widely dilated and fixed. Accommodation was completely paralyzed. The fundi in both eyes were normal, and form fields were normal. The cornea of both eyes showed an old interstitial keratitis.

In the position of rest, the right eye was fixed and the left eye was divergent. If both lids were closed and the left lid elevated manually, the left eyeball moved in from divergence toward the midline in an attempt to fix. With both eyes opened, it could be clearly seen that the movement of the left eye occurred only when the right eye was turned outward. No motion of the left eye inward was possible save when the right was strongly abducted, but this occurred each time the patient was directed to look to the right.

Treatment and Course.—The patient was immediately given potassium iodide and mercury, and later he was placed under Dr. Klauder's care for antisyphilitic treatment consisting of injections of bismuth, potassium iodide and mercury. The Wassermann test of the blood was negative.

On May 25, 1929, the ptosis had markedly improved, but the deviation of the left eye was unchanged. At this time, however, there was beginning power in the internal rectus, as evidenced by the fact that the patient could draw the left eye in to fix while the right eye was looking straight ahead. From this time on improvement was marked, and to date the movements of the left eye in all directions are full. The pupil is still semidilated and shows no reaction, and accommodation is still paretic.

This patient, therefore, showed movement inward of the left eye toward the midline in spite of a complete paralysis of the third nerve on the left side. No injection of procaine hydrochloride was made into the left internal rectus muscle; so it cannot be positively stated that this muscle was completly paralyzed as in case 1. The whole picture, however, was sufficiently convincing for one to regard this as highly probable, and it is belived that the movement inward of the left eye was due solely to a diminution in the tone of the right external rectus which comprises reciprocal innervation.

It is probable that the reason reciprocal innervation has been overlooked or even denied in these cases of paralyisis of the ocular muscle is that the patients have not been examined early enough. It is a well recognized fact that contracture of the unparalyzed external rectus muscle soon begins in these cases. As Fuchs [9] stated; "While in a recent paralysis of the externus, the eye, when the gaze is directed straight forward, stands in the midline, it afterwards becomes drawn in more and more, and can no longer be drawn up to the median position." This is probably the reason that the condition was not so evident in case 1 as in case 2, since the patient in case 2 was first seen two weeks after the onset of the trouble while the patient in case 1 was not seen until five weeks after onset.

CONCLUSION

These cases demonstrate that reciprocal innervation of the ocular muscles does exist in man. The inward movement of one eye in the presence of a complete paralysis of the third nerve when the fellow eye is abducted can be explained only by an inhibition of the contractile activity of one external rectus associated with the increase in contractile activity of the opposite antagonistic external rectus.

9. Fuchs, E.: Text Book of Ophthalmology, ed. 7, Philadelphia, J. B. Lippincott Company, 1923, p. 309.

SUBCONJUNCTIVAL INJECTION OF PREGL'S SOLUTION IN GONORRHEAL OPHTHALMIA *

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In 1925, Stellwagen decided to treat patients for gonorrheal arthritis by injecting Pregl's solution (a complex hypo-iodite preparation) directly into the prostate. The results obtained were so good that since then Stellwagen's method has been part of the routine treatment for gonorrheal arthritis in the Philadelphia General Hospital.

In view of the excellent cures obtained from the use of Pregl's solution in the wards for genito-urinary diseases in the Philadelphia General Hospital, it was suggested by Dr. Searle H. Lanyon that, if properly administered, it might be effective in the treatment for gonorrheal ophthalmia in adults. He, together with Dr. Emil Senger, had used it subconjunctivally in a case and had obtained favorable results. As a consequence, it was determined to try Pregl's solution in a series of unselected cases.

TECHNIC

Some preliminary tests were made, and the following procedure was adopted: After thorough irrigation of the eye with boric acid solution and the instillation of a drop of 1 per cent holocaine hydrochloride, 15 minims (0.92 cc.) of Pregl's solution was slowly injected under the highest point of the edematous bulbar conjunctiva. A feeling of discomfort occurs immediately after the injection, but passes off in about fifteen minutes. This injection is given every day, as long as the laboratory report remains positive for gonococci. At the same time, the patient is given the usual routine treatment, consisting of cold compresses for ten minutes every hour, unless there is corneal involvement; irrigation with a 1 : 10,000 solution of sodium oxymercury orthomitrophenolate, as often as the amount of secretion warrants; instillations of atropine sulphate to keep the pupil dilated, and a daily application of 1 per cent silver nitrate solution when it can be applied to the everted lids. Zinc sulphate, 0.25 per cent solution, is used in the third stage. A conjunctival smear is examined daily for gonococci, and the patient is considered free from the infection only after the laboratory report has been negative for three consecutive days.

The six cases reported are from the department of ophthalmology of the Philadelphia General Hospital.

CASE REPORTS

CASE 1.—E. H., a man, white, aged 24, was admitted to the ward on June 21, 1928, with the lids of the right eye red and swollen, profuse mucopurulent discharge and severe ecchymosis of the bulbar conjunctiva. The cornea was clear. The laboratory report showed the presence of gonococci. The left eye was normal.

* Submitted for publication, Jan. 6, 1930.

* Read before the Section on Ophthalmology of the College of Physicians of Philadelphia, Dec. 19, 1929.

The condition started on the morning of the day of admission. When the patient awakened, there was a watery discharge from the right eye, the lids of which were very much swollen. Later in the day, the discharge became thick and yellow. He had had gonorrheal urethritis for two weeks.

Fifteen minims of Pregl's solution was injected subconjunctivally, and routine treatment was begun.

June 22: The lids of the right eye were very much swollen. The discharge was profuse, thick and purulent. The edema of the conjunctiva was more intense. Fifteen minims of Pregl's solution was injected.

The conjunctiva of the left eye was injected, and there was a slight mucoid discharge. A smear of this eye was sent to the laboratory. Fifteen minims of Pregl's solution was injected, and the Buller shield was replaced.

June 23: The discharge from the right eye was still profuse; the edema was more marked. There was a beginning superficial infiltration of the lower quadrant of the cornea. Fifteen minims of Pregl's solution was injected. The left eye was slightly injected. There was no discharge. The laboratory report for the left eye was negative for gonococci.

June 24: The condition of both eyes was about the same. Fifteen minims of Pregl's solution was injected in the right eye.

June 25: From the right eye there was much less discharge, and it was not so thick. The infiltration in the lower portion of the cornea was more marked, and slight infiltration was beginning in the upper quadrant. Fifteen minims of Pregl's solution was injected. The left eye was clear.

June 26: The discharge was much less profuse, and was thin. The whole cornea was slightly cloudy. Fifteen minims of Pregl's solution was injected.

June 29: The condition was about the same. Fifteen minims of Pregl's solution was injected.

June 30: There was still some slight watery discharge. The cornea was clearing around the periphery; the central portion was smaller but still dense. Fifteen minims of Pregl's solution was injected.

July 1: The condition was about the same. Fifteen minims of Pregl's solution was injected.

July 2: There was a slight watery discharge. The cornea was clear, except for a grayish, linear, translucent scar diagonally across the center of the cornea, about 3 mm. in length. Fifteen minims of Pregl's solution was injected.

July 4: The eye was quiet. Fifteen minims of Pregl's solution was given. The laboratory report was negative for gonococci.

July 6: A negative report was received from the laboratory for the third consecutive day. The conjunctiva was still red. There was no secretion. The patient was discharged from the hospital and was given a 0.25 per cent zinc sulphate solution.

July 25: The eye was perfectly quiet. There was a slight unevenness and scarring of the palpebral conjunctiva, and a small central opacity of the cornea, about 1.5 × 3 mm. long. Vision could be corrected to 6/12.

CASE 2.—J. K., a man, colored, aged 28, was admitted to the ward on June 23, 1928. The lids of the right eye were very much swollen and edematous. The bulbar conjunctiva was chemotic, overlapping the limbus all around. There was a great deal of thick, purulent discharge. The cornea was clear. The laboratory report was positive for gonococci. The left eye was normal.

The condition started on June 18, 1928, since which time there had been no treatment. The patient was found to have gonorrheal urethritis, of which he claims to have been unaware.

Fifteen minims of Pregl's solution was injected and routine treatment was started.

June 24: There was practically no change. Fifteen minims of Pregl's solution was injected.

June 25: The secretion contained less pus. The conjunctiva was less swollen. Fifteen minims of Pregl's solution was injected.

June 26: The discharge was watery. There was little edema of the conjunctiva. Fifteen minims of Pregl's solution was injected.

June 27: There was a slight, watery discharge, and hardly any edema. Fifteen minims of Pregl's solution was injected.

June 28: There was still a slight watery discharge. Beginning infiltration of the cornea could be seen at 6 o'clock. Fifteen minims of Pregl's solution was injected.

June 29: The cornea was clear, except for a very small opacity at 6 o'clock; otherwise, the eye seemed the same as when last seen. Fifteen minims of Pregl's solution was injected.

June 30: The eye was quiet. Hardly any discharge and very little swelling was present. The laboratory report of the smear taken on June 29, was negative for gonococci.

July 2: The daily smear had been found negative for gonococci since June 29.

July 16: The palpebral conjunctiva was slightly thickened, but the eye was quiet. The cornea was clear, except for a small white scar at 6 o'clock. Vision was 6/6.

CASE 3.—J. B., a man, colored, aged 73, was admitted in the service of Dr. Thomas O'Brien on July 28, 1928. The lids of the right eye were red and greatly swollen. The conjunctiva was intensely injected and swollen, and the chemotic bulbar conjunctiva overlapped the limbus all around. The entire cornea was infiltrated, more intensely in the center, with almost complete loss of vision. There was a profuse, purulent secretion. The laboratory report was positive for gonococci. The left eye was normal.

He said that he had had a discharge from the right eye for a week previous to his admission. Three days before, the eye became very red, and there was a profuse, pinkish discharge.

Fifteen minims of Pregl's solution was injected and routine treatment was started.

June 29: The condition was somewhat worse. The discharge was thick and profuse, and there was complete loss of transparency of the cornea. Fifteen minims of Pregl's solution was injected.

June 30: The infiltration in the center of the cornea was dense, thickened and surrounded by a dark, brown ridge, probably a beginning abscess. Fifteen minims of Pregl's solution was injected.

June 30: A small hypopyon, 2 mm. high, could be seen through the very cloudy cornea, but the dark ring had disappeared. The discharge was profuse. Fifteen minims of Pregl's solution was injected.

August 1: The condition was about the same. Fifteen minims of Pregl's solution was injected.

August 1: The condition was about the same. Fifteen minims of Pregl's solution was injected.

August 2: There was little, if any, improvement in the cornea. The discharge was much less profuse and almost watery. Fifteen minims of Pregl's solution was injected.

August 3: There was a thin discharge. The hypopyon was almost entirely gone. The laboratory report of a smear taken the day before was negative for gonococci.

August 4: Some portions of the cornea were beginning to clear. There was little discharge and little edema of the conjunctiva.

August 5: The condition was improved. The cornea continued to clear. The laboratory report for the third consecutive day was negative.

August 13: The corneal surface was slightly irregular, but transparent, except for a well defined, dense, central scar, 3 mm. in diameter, and a linear white scar across the lower portion of the cornea, 1.5 mm. in length. Vision could be corrected to 6/30.

CASE 4.—N. J., a man, colored, aged 18 years, was admitted to the ward on Aug. 10, 1928, in the service of Dr. Thomas O'Brien. The lids of the left eye were much swollen; the bulbar conjunctiva was edematous, overlapping the limbus all around; there was beginning infiltration of the upper and lower quadrants of the cornea and a profuse, purulent discharged. The laboratory report was positive for gonococci. The right eye was normal.

The condition started three days before admission, with pain and redness of the left eye.

Fifteen minims of Pregl's solution was injected, and the patient was started on routine treatment.

August 11: The discharge was profuse, and the corneal infiltration more marked. Fifteen minims of Pregl's solution was injected.

August 12: The corneal infiltration had increased and the entire surface was faintly cloudy with dense areas in the upper and lower quadrants. Fifteen minims of Pregl's solution was injected.

August 13: There was less edema of the conjunctiva; the discharge was quite thin and the cornea about the same. Fifteen minims of Pregl's solution was injected.

August 14: The discharge was thin and much less profuse. The cornea was beginning to clear up. The laboratory report of a smear taken the day before proved negative for gonococci.

August 15: The conjunctiva was still swollen and red, but there was little discharge and the cornea was clearing.

August 16: There was still marked swelling and redness of the conjunctiva, but no discharge. The cornea was smooth and clear, except for a dense white scar, 2 mm. high, at the lower limbus. Vision was normal. A negative laboratory report was received for the third consecutive day.

CASE 5.—J. C., a man, white, aged 26, was admitted to the ward in the service of Dr. Thomas O'Brien, on Aug. 4, 1928, with a profuse purulent discharge from the right eye; the lids were swollen and hard, the conjunctiva edematous. The cornea was clear. The laboratory report was positive for gonococci. The left eye was normal.

The right eye became irritable and watery four days before admission, since which time there had been no treatment. He had had gonorrheal urethritis for one month.

Fifteen minims of Pregl's solution was injected subconjunctivally, and routine treatment was started.

August 5: The discharge was still profuse. The condition was about the same. Fifteen minims of Pregl's solution was injected.

August 6: The discharge was not nearly so thick, and the quantity was reduced. Fifteen minims of Pregl's solution was injected.

August 7: The discharge was subsiding and was thin and watery. There was little swelling. Fifteen minims of Pregl's solution was injected.

August 8: There was a small amount of thin discharge and little or no swelling. The laboratory report of a smear taken the day before was negative for gonococci.

August 9: There was a slight watery discharge. The laboratory report of a smear taken the day before was negative for gonococci.

August 10: There was a slight increase in the watery discharge. The laboratory report of a smear taken the day before showed a few gonococci. Fifteen minims of Pregl's solution was injected.

August 11: The eyes were almost entirely quiet. The laboratory report of a smear taken the day before showed a few gonococci. Fifteen minims of Pregl's solution was injected.

August 12: There was hardly any discharge. There was some injection and thickening of the conjunctiva. The laboratory report of a smear taken a day before was negative for gonococci.

August 14: The eye was quiet and the cornea clear; vision was 6/6. The laboratory report was negative for the third consecutive day.

CASE 6.—E. S., a woman, white, aged 20, was admitted to the ward on Aug. 7, 1929, in the service of Dr. Thomas O'Brien. The left eye was greatly swollen and boardlike, with a profuse purulent discharge. The edema of the conjunctiva was so great that the lids could not be closed. The cornea was clear. The laboratory report was positive for gonococci. The right eye was normal.

The condition started three days before admission, with swelling and discharge. Fifteen minims of Pregl's solution were injected subconjunctivally, and routine treatment was started.

August 8: The lids were still swollen and hard. The conjunctiva was still ecchymotic, and the palpebral surfaces were covered with a thin pseudomembrane. The discharge was about the same. Fifteen minims of Pregl's solution was injected.

August 9: The condition was about the same. Fifteen minims of Pregl's solution was injected.

August 10: The discharge was thin and less profuse. There was a considerable reduction of the swelling of the lids and conjunctiva. The false membrane was still present. Fifteen minims of Pregl's solution was injected.

August 11: The swelling of the lids and conjunctiva continued to decrease, but the false membrane was still present. The discharge was becoming watery. Fifteen minims of Pregl's solution was injected.

August 12: The swelling had almost entirely subsided. There was a slight, watery discharge. The membrane had disappeared. Fifteen minims of Pregl's solution was injected.

August 13: There was hardly any swelling and almost no discharge. The conjunctiva was still injected. The laboratory report of a smear taken the day before was negative for gonococci.

August 15: There was little injection and swelling of the conjunctiva and no discharge. The laboratory report was negative for gonococci for the third consecutive day.

August 19: The conjunctiva of the lids was slightly red, with some folliculosis. Vision was 6/5.

COMMENT

Gonorrheal ophthalmia in adults is a more serious condition than ophthalmia neonatorum. Involvement of the cornea in gonorrheal

ophthalmia of adults is almost constant, while in infants, with timely and proper treatment, it is rare. The so-called "mild" cases of gonorrheal ophthalmia in adults are seldom, if ever, seen at the Philadelphia General Hospital, because nearly all the patients are admitted after having been treated outside for some time. Case 1 is an exception; but this was a particularly virulent infection, as the onset was so rapid.

The duration of the infection in the six patients treated was, respectively, 13, 6, 5, 3, 7 and 5 days, an average of 6.5 days. Case 5, given as of seven days' duration, was practically free from organisms in three days, only a few gonococci having been found on the sixth and seventh days.

In only one of the eyes was useful vision lost. This was in case 3, that of a man aged 73 whose cornea was nearly opaque on admission. In four of the cases the vision was unaffected; in case 1, vision was 6/12.

One other feature should be considered in this series: In no instance was more than one eye involved. This, of course, must be credited to good nursing and careful prophylaxis. Whether or not the treatment had any bearing on this fact cannot be said.

THE EXTENT OF THE FIELD OF VISION IN LENS MICROPSIA *

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The most commonly observed effect of micropsia is the apparent reduction in the size of visual objects. Aside from the spontaneous appearance of micropsia in pathologic states, such as disseminated choroiditis and primary retinitis,[1] it can be artificially produced by any means which interfere with the normal correspondence of convergence with accommodation. Thus micropsia can be induced by the use of mydriatics,[2] which paralyze the accommodation to a greater or lesser degree; the Hering haploscope; the mirror stereoscope, and prisms.[3] Concave lenses, which in respect to the induction of micropsia belong with the other instruments named, lend themselves to a simple and easy procedure and involve none of the discomforts that accompany the use of mydriatics. It is for these reasons, and perhaps because with a lens before the eye the point of fixation may be at any distance in a room and not limited within the restricted scope of a more complicated instrument like the others named, that the few who have investigated micropsia have usually employed concave lenses.

Whichever means is employed to induce micropsia, it is clear that the phenomenon does not depend on a reduction in the size of the retinal image. Superficial consideration of the dioptrical properties of the eye under the influence of mydriatics or of the properties of all the instruments named, except the concave lenses, demonstrates at once that it is physically impossible for the retinal image to have undergone any reduction in size. In the case of concave lenses, Kaila [4] has shown that with a glass of —3 diopters the reduction in the size of the retinal image is physically but one-thirteenth. This is so much less than the corresponding subjective reduction in the experienced size of visual objects that it would be unreasonable to regard it as an adequate cause,

* Submitted for publication, Jan. 1, 1930.

* From the Department of Psychology, University of Louisville.

1. Parsons, J. H.: Diseases of the Eye, New York, The Macmillan Company, 1927, pp. 321 and 334.

2. Koster, W.: Zur Kenntnis der Mikropie (sic) und Makropie (sic), Arch. f. Ophth. **42**:35, 1896.

3. Jaensch, E. R.: Zur Analyse der Gesichtswahrnehmungen, Ztschr. f. Psychol. **4**:46, 77, 91 and especially 94-117, 1909.

4. Kaila, E.: Eine neue Theorie des Aubert-Foersterschen Phänomens, Ztschr. f. Psychol. **86**:193 and especially 224, 1921.

especially in view of the fact that micropsia can be produced by other means in which no physical reduction in the size of the retinal image is involved.

It seems more nearly probable that the experienced reduction in the size of visual objects in micropsia depends on psychologic factors associated with the derangement of the normal correspondence of convergence with accommodation. Koster's [2] explanation, which follows, is of this character. All of the instruments mentioned, including concave lenses, elicit for any given accommodation a greater than normal convergence. The result is that, kinesthetically at least, the observer experiences visual objects at a distance less than the real one. But retinally the image does not at the same time increase, as experience has taught one to expect when an object approaches, Therefore an automatic, and unconscious, inference is drawn; namely, that, since the distance has grown smaller and the image has remained constant, the visual object must have suffered a decrease in size. In view of the dynamic character of perception which modern psychology [5] has demonstrated, it is difficult to accept this explanation literally. It is safe to accept it, however, so far as it denies a supposed physical reduction in the size of the retinal image as a cause.

Koster [2] and Jaensch [3] described still a second effect of micropsia. In micropsia the apparently reduced objects in the field of vision undergo distinct qualitative changes. Chromatic saturation is increased; white becomes more intense, and black becomes darker. On the whole it seems as if an intervening mist were removed from the foreground of the field of vision, and to the rise in saturation is added a heightened distinctness of detail. This qualitative accompaniment to micropsia Jaensch has named the Koster effect.[3]

It has been supposed by Jaensch that, because in micropsia the total field of vision becomes subjectively contracted and because details become more distinct, an objective extension of the field resulted from the use of a concave lens. More specifically he argued that in micropsia more distantly eccentric details in the field could be resolved than normally;[3] that is to say, the acuity of any peripheral spot on the retina would become increased. He based this on experimental observations of little reliability. He simply accepted the statements of observers, including himself, that they were certain that with a glass they saw a larger part of the field, and that all the peripheral details had become more distinct.[3] In a later work,[6] involving micropsia produced by prisms, he concluded that an increase in micropsia accompanies an

5. Köhler, W.: Gestalt Psychology, New York, Liveright, 1929.

6. Jaensch, E. R., and Schönheinz, Wilhelmine: Einige allgemeinere Fragen der Wahrnehmungslehre, Arch. f. Psychol. **46**:3, 1924.

extension of the field of vision, and that the factors that favor micropsia also favor the extension of the visual field. These declarations, however, do not harmonize with the actual quantitative investigation that he made with one observer.[3] Here, curiously, measurement showed no extension. But he passed the inconsistency off with the declaration that the lens was too weak to produce a high enough degree of micropsia. Yet Emmert[7] found also that, while atropine produced the qualitative effects of micropsia, it did not result in an extension of the visual field.

PROBLEM

For reasons of theoretical importance,[3] and also because it is well to understand all the modifications that concave lenses introduce into the world of the myopic, it seemed advisable to determine by a rigid experimental procedure whether concave lenses do extend the field of vision and thereby heighten peripheral acuity.

METHOD

Preliminary Procedure.—Five observers were employed, each one selecting a concave lens capable of producing in him a pronounced micropsia. The selection of lenses was as follows: for observer B, —3 diopters; E, —2; W, —2; F, —4, and G, —2. Observations were made monocularly of details in a field 4 meters distant, first with the naked eye and then with the glass placed before the right eye. All agreed on the presence of the Koster effect, involving, in micropsia, an intensification of the entire field, an increase in chromatic saturation and a greater transparency of the air medium.

Quantitative Procedure.—The agreement with the qualitative factor of Jaensch's description being established, it remained to determine quantitatively whether the field became extended peripherally, as he assumed. The procedure was based on the following reasoning. If micropsia really effects an extension of the field of vision, such an extension ought to manifest itself at the perimeter in the form of heightened acuity at the periphery; in other words, the resolution of a constant test object should occur at a greater angle of eccentricity with micropsia than without it. A test object, black squares, 5 by 5 mm., on a white ground, with a 5 mm. space between, was employed. At first the object was slid from the fixation point to the periphery, the observer reporting at the moment when resolution ceased. These data are given under the heading "Disappearance." Then the same object was brought in from the extreme periphery toward the center, the observer reporting the exact moment of initial resolution. These data are given under the heading "Appearance." Four observations each were made for "Disappearance" and "Appearance," with the bare right eye. The same observations were made by each of the four observers (for the quantitative work observer W was not available), with the appropriate concave lens before the right eye, that is, under the influence of micropsia. In order to eliminate the effects of practice and fatigue, the order of observation with and without the lens was appropriately alternated. As a control an L-shaped test object was employed, the

7. Emmert, R.: Die Micropsie, Arch. f. Augenh. u. Ohrenh., 1882, p. 95.

observer being obliged to report the direction of the arms. Naturally, owing to its character the L-shaped figure could be employed only for "Appearance"; i. e., it was presented from the extreme periphery toward the center. Each angle of the data in the table represents the peripheral point at which resolution occurred and is the average of four observations.

Examination of Field of Vision

Squares

Observer	With Micropsia		Without Micropsia	
	Appearance, Degrees	Disappearance, Degrees	Appearance, Degrees	Disappearance, Degrees
B	10	21	11	21
E	18	28	20	29
G	11	13	11	15
F	18	23	20	24

L-Shaped Figure

Observer	With Micropsia. Appearance Only, Degrees	Without Micropsia. Appearance Only, Degrees
B	12	12
E	17	20
G	12	12
F	19	20

* For all the results, the mean variation ran from 23 minutes to 1 degree 45 minutes, clearly a small range of variation and consequently of probable error.

All the data in the table were secured from the upper right diagonal meridian of the field of vision of the right eye. This particular meridian was selected because with the daylight illumination it was the only meridian at which the perimeter appeared uniformly illuminated throughout its entire arc. Before observations were made, the observer was allowed to look through the lens for a sufficient time to overcome the sense of strain and strangeness and to get fairly well adapted.

CONCLUSION

Under the influence of lens micropsia the field of vision does not increase in extent in the slightest degree. (It is noteworthy that whatever little advantage was present was enjoyed by the bare eye. This was probably due to unavoidable slight strains in the eye that accompanied the use of the lens and so made vision slightly more difficult.) It therefore follows that if an objective measure is to be worked out for determining the amount of micropsia experienced in a given instance, it is fruitless to seek this measure in terms of increase in the objective field of vision. Since, however, the Koster effect has been repeatedly confirmed, it follows that an objective measure of micropsia may properly be sought, in the future, in color and intensity equations between the bare eyes and the eye with micropsia.

Ophthalmologic Review

SCLEROSIS OF THE RETINAL ARTERIOLES*

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Pathologic changes in the retina have always been of interest to the ophthalmologist because of their effect on vision, and to the internist because of their significance in the diagnosis and prognosis of systemic diseases. Sclerosis of the retinal vessels affects vision in the main only when it becomes sufficiently advanced to interfere with the nutrition of the retina or when it is complicated by hemorrhage or edema. Recognition of its early stages is of considerable value, however, in the study of diseases of the cardiovascular system, especially if its relationship to sclerosis in other parts of the body can be clearly defined. Much has been written both on the ophthalmoscopic signs of retinal arteriosclerosis and on its interpretative significance. In the latter especially, a distinct trend toward clarification of the situation can be noted during recent years. It has seemed interesting and valuable to review briefly the rather extensive literature with a view more to emphasizing this trend than to being absolutely comprehensive. From the mass of material, therefore, an attempt has been made to select those facts which, to a rather personal point of view, seem significant and which mark the progress that has been made in a period of about fifty years in the study of the retinal vessels ophthalmoscopically and histologically and in their relationship to general systemic disease. For convenience, ophthalmoscopic signs, histology, pathogenesis, clinical significance and complications are considered separately.

OPHTHALMOSCOPIC SIGNS

In 1876, Gowers called attention to the generalized reduction in size of the retinal arteries in certain patients with chronic Bright's disease associated with increased arterial tension. In 1889, Raehlmann published the first extensive description of sclerosis of the retinal arteries. He recognized as signs of sclerosis, tortuosity and attenuation of the arteries, patchy narrowing of the lumen at circumscribed points

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of the course of the vessel, and white sheathing. He mentioned the rare occurrence of aneurysms of the central artery or its branches. In association with these changes in the arteries, he found compression of the veins at crossings of arteries, ectasia in the veins mainly peripheral to the point of arterial compression, and white sheathing of the veins. He called attention to the fairly frequent occurrence of locomotor arterial pulse and peripherally progressive venous pulse. These pulse phenomena had also been noted by Thoma. Besides the sclerosis found in association with general arteriosclerosis, Raehlmann described sclerosis of the retinal arteries the result of local retinal disease, the main features of which were narrowing of the blood stream in the arteries with or without visible thickening of the walls of vessels, the appearance of white lines along the vessels, and at times ultimately the transformation of the arteries into opaque white strings; the latter, as Gipner and I have pointed out, is probably due to arterial thrombosis. In 1898, Gunn gave an adequate description of sclerosis of the retinal arteries in which he brought out, in addition to the signs noted by Raehlmann, the narrowing and increased brightness of the central light streak of the arteries, the change to an unusually light color of the entire breadth of the artery, and the loss of translucency of the arterial wall.

Since the publications of Raehlmann and Gunn, little really new has been added to the knowledge of the ophthalmoscopic evidences of arteriosclerosis, although a number of authors have endeavored to elaborate, explain and classify the signs of sclerosis previously described. Rohmer called attention to the attenuation of the arteries in the retina of aged persons without definite arteriosclerosis. De Schweinitz noted, in certain cases of arteriosclerosis, the occurrence of corkscrew terminal arterioles, especially in the macular region, and of a dusky red congested disk. Moore noted the right-angled type of arteriovenous compression as a sign of rather advanced sclerosis.

Bardsley attempted to separate the signs produced by high blood pressure from those produced by actual sclerosis. He correctly interpreted irregularity of caliber and "beading" as positive evidences of sclerosis, but his contention that high blood pressure gives rise to uniform distention and fulness of the vessels is open to question. As a rule, the first retinal sign of rapidly rising blood pressure is definite arterial constriction. Adams also called attention to this. Bardsley and Agatston expressed the belief that by correctly interpreting the evidences of high blood pressure in the retina, they can correctly estimate the systemic blood pressure. This would seem to be a rather difficult and usually unnecessary feat. The type of the hypertension and the rapidity of its rise often play a larger part than its actual figures in millimeters of mercury in determining the presence or absence of

pathologic changes in the retinal arteries. Bailliart stated the belief that measurement by the dynamometer is the only sure method of detecting raised pressure in the retinal arteries.

To facilitate the recognition of sclerosis of the retinal arteries which can be interpreted as a part of a diffuse vascular disease, I suggested classifying retinal arteriosclerosis into four types: consecutive (hypertension), primary, secondary (postinflammatory) and senile. I attempted to distinguish from among the general signs of sclerosis, those which were especially characteristic of each of these groups. Thus, I called attention to the relatively uniform involvement of the arteries and especially to their generalized constriction in the hypertension type, to the more irregularly distributed and the more obliterative character of the sclerosis in the primary (atheromatous or inflammatory) type, to the predominance of perivascular changes in the sclerosis secondary to edema or inflammation of the retina or optic nerve, and to the general attenuation of the vessels, and their loss of sheen in the senile retina.

The recent extensive articles by Pines seem to be concerned more with the explanation or interpretation of the well recognized signs of retinal arteriosclerosis than with the description of any new or significant diagnostic facts. He expressed the belief that most of the ophthalmoscopic evidences of arteriosclerosis are due to changes in a rather theoretic "perivascularis." His ideas are not supported by any direct histologic evidence and so, for the present, must be considered unproved. Salus believes that the appearance of arteriovenous compression is produced by the shoving of the vein back into the retina so that a layer of tissue is interposed between the artery and vein and prevents interference with the venous circulation. This possibility was primarily mentioned by Leber.

It is often difficult to interpret correctly such terms as "silver wire arteries," "copper wire arteries," "beading," "pipe-stem sheathing," and the like, used by various authors in their descriptions of retinal arteriosclerosis. They probably refer to phases of increased brilliancy of the light reflex, constriction and change in color of the arteries, irregularity of lumen and perivascular thickening. Their use adds confusion rather than light to the subject. Simplification of terminology and the recognition of a few positive signs, rather than a multiplicity of doubtful ones, are to be desired since they make the diagnosis of retinal arteriosclerosis more accessible to the average ophthalmologist and internist.

HISTOLOGY

The histologic changes underlying the ophthalmoscopic picture of sclerosis of the retinal arteries are not accurately understood. In most of the eyes available for histologic examination, the sclerosis is com-

plicated by the presence of retinitis. Gull and Sutton were of the opinion that the lesion in the arterioles in the retina, as well as elsewhere in the body, was of a hyaline-fibroid nature. Karl's view was essentially the same. He found a homogeneous thickening of the walls of the retinal arteries which he believed started from without as edema with subsequent hyaline thickening and degeneration. Subsequent authors, Hertel, Raehlmann, Parsons, Coats, and Leber, described both increase in the connective tissue and elastic elements of the arterial walls with subsequent hyaline degeneration and endarteritis with proliferation of the endothelium of the intima, which latter they seemed to regard as the primary and most essential change. Cohen presented excellent photomicrographs of sclerosed retinal arteries, but did not give a detailed description of the characteristics of the sclerosis. Bailliart listed the histologic changes in sclerosis of the retinal arteries as: fibrous thickening of the adventitia, thickening of the intima with atrophy of the endothelium, hyperplasia of the muscle tissue of the media with hyaline replacement, and finally hyaline narrowing and obliteration. Keith, Wagener and Kernohan found in the retinal arterioles, the vessels in which sclerosis as a part of general vascular disease is mainly observed ophthalmoscopically, that the sclerosis is due principally to fibrous thickening of the media and to an increased number of delicate fibrils around the adventitia. Less frequently, and probably as a later stage of the process, definite thickening of the intima due to endothelial proliferation is found.

PATHOGENESIS

The pathogenesis of the sclerosis of the retinal arteries occurring in association with general arterial disease is obviously the same as that of arteriosclerosis, or rather arteriolosclerosis, in general; an extensive discussion of the various theories of its source hardly comes within the scope of this review. However, ophthalmoscopic examination lends considerable support to the theory of the development of sclerosis through the nutritional changes which result from vasoconstriction. Gunn believed that there was an increased tightness in the arteries which diminished the rapidity of the blood stream in the capillaries and veins with a resultant tendency for the escape of serum into the surrounding tissues. He thought that the persistence of this edema interfered with the nutrition of the blood vessels and led to a progression of the arterial changes. Bailliart is of the opinion that local hypertension in the retinal arteries interferes with their nutrition and leads to sclerosis and atheroma. Pines stated: "The hard artery of a hyperpietic starts as a tonic contraction of the muscularis media. This purely functional tonic contraction of the media may be present for

years without any histologic changes; then it leads to hypertrophy of the muscularis media (myohypertrophy) or to fibrosis."

Observation of the progressive changes in the retinal arteries in the hypertension of the toxemia of pregnancy strongly supports Gunn's views. Mylius has found in the preeclamptic stage of the toxemia of pregnancy definite transitory localized spastic constrictions of the retinal arteries which change rapidly in situation and degree. As the toxemia increases in severity, these constrictions assume a tetanic form and can persist unchanged for several hours or days with resultant stasis of the circulation and passive hyperemia in the capillaries, and edema and hemorrhage into the surrounding retina. When the toxemia is relieved by delivery or other measures, the tetanic constrictions relax and the vessels regain their normal appearance. It has been my impression in observing cases similar to those of Mylius that permanent organic changes in the walls of the vessels develop on the basis of these tetanic constrictions, especially when localized edema and hemorrhage occur secondarily in the retina. One of Mylius' cases suggests such a sequence. It is difficult to determine whether these organic lesions develop as a result of ischemic injury to the wall of the vessel primarily, or secondarily through the influence of the persistent edema in the surrounding retina.

CLINICAL SIGNIFICANCE

In 1876, Gowers stated that in a retina free from local disease, any marked change in the vessels might be taken as evidence of a similar change throughout the vascular system, and that the contraction of the retinal arteries seen in certain cases of chronic Bright's disease was always associated with cardiac hypertrophy. He said also: "Moreover, as affording definite information regarding the pathological process in different cases of Bright's disease, it (the inspection of the retinal vessels) will, I think, have considerable value; and . . . ultimately it may help us better to distinguish between morbid states included under the term and at present imperfectly distinguished." Many authors have elaborated on these general statements in which Gowers furnished the framework for the interpretative study of the retinal vessels in their relationship to systemic vascular disease.

Friedenwald found demonstrable peripheral arteriosclerosis in 94 per cent of a group of patients with sclerosis of the retinal arteries; I found it in 70 per cent. Statistics by various authors differ considerably as to the percentage of cases of general arteriosclerosis in which retinal arteriosclerosis is present. Thus Hirschberg gave 46 per cent; Friedenwald, 82 per cent; Raehlmann, 50 per cent; Rud and Møller, 4 per cent and I, 80 per cent (hypertension cases). It is probable that the difference in figures depends on the number of cases in the groups studied in which the peripheral arteriosclerosis was asso-

ciated with hypertension. For it is becoming obvious, as noted by Pines, that sclerosis of the retinal arterioles is associated with sclerosis of the arterioles throughout the body and is a sign of hypertensive disease and not of atherosclerosis. It has been definitely shown by O'Hare and Walker and by Yater and Wagener in their studies of patients with cardiac disease that retinal arteriosclerosis indicates either present or past hypertension. If a patient with cardiac decompensation shows sclerosis of the retinal arteries, the disease is the result of hypertension, entirely or in part, even though the blood pressure is normal or low at the time of examination. Altnow's figures also support these facts.

The relationship between retinal and cerebral arteriosclerosis is in reality based on the same premise. Such authors as Raehlmann, Rohmer, de Schweinitz, Geis and Moore believe that sclerosis of the retinal arteries always indicates sclerosis of the cerebral arteries. It must be remembered, however, that if the sclerosis is slight in the retina, usually it will be slight also in the brain and that it will therefore be asymptomatic at best for some time. This fact accounts for the seemingly low incidence of cerebral vascular lesions in patients with retinal arteriosclerosis. Twenty-one per cent of Raehlmann's patients with retinal arteriosclerosis had cerebral hemorrhages, whereas 18 per cent of the patients in my series had cerebral arteriosclerosis which could be diagnosed clinically. Of Adams' one hundred and fifty-six patients with retinal vascular lesions, twenty-two (14 per cent) died of cerebral hemorrhage or stroke. Moore found evidence of gross cerebral vascular lesions in 31 per cent of thirty-five patients with retinal arteriosclerosis, and in 44 per cent of sixty-six of his patients with symptoms of the eye due to retinal arteriosclerosis (relatively severe sclerosis). Knapp stated that Geis traced the history of seventeen patients with distinct retinal arteriosclerosis and found that all had died of apoplexy within four years.

It must also be remembered that certain cases of cerebral arteriosclerosis are associated with low blood pressure and not with hypertension. This fact probably accounts, in part, for the 30 per cent of advanced disease of the cerebral vessels in which Moore did not find retinal arteriosclerosis. Gunn found retinal arteriosclerosis in 59 per cent of seventeen cases of gross cerebral vascular lesions, Moore found it in 70 per cent of forty-four cases and I in 74 per cent of twenty-seven cases of clinical cerebral arteriosclerosis.

Since the time of Gowers and Gunn, the frequent association of sclerosis of the retinal arteries with chronic nephritis has been widely recognized. The question of the interdependence between the two brings up the whole subject of the rôle of the kidney in the causation of hypertension, a subject rather too involved for the present review.

The trend of modern opinion seems to be toward the belief that, in cases of nephritis associated with hypertension, the sclerosis of the retinal and of the renal arteries is part of a general vascular disease, the etiology of which is unknown.

Retinal arteriosclerosis of the senile type has been found to be associated usually with benign hypertension of a low grade. In patients with angina pectoris, it is seen more frequently than the ordinary hypertension type of sclerosis. I believe that observation of the increase or lack of increase in the grade of sclerosis of the retinal arteries will aid in distinguishing progressive from nonprogressive or benign hypertension.

COMPLICATIONS

Lesions in the retina which can be justly considered as complications of sclerosis of the retinal arteries are aneurysm, spasm, hemorrhage, thrombosis of the retinal veins and arteriosclerotic retinitis. The significance of each of these entities would perhaps justify an independent review. A few of the salient points seem worthy of mention here.

Aneurysms.—Aneurysms of the central artery and its branches were mentioned by Raehlmann as one of the signs of arteriosclerosis. They are rare. Their origin and significance are not well understood. Leber stated that between points of constriction in the retinal arteries caused by thickening of the intima there are often slightly dilated spots with, here and there, small ectasia or the beginning of miliary aneurysms. Bailliart expressed the belief that aneurysms may be primary or secondary to arterial obliteration. Fernandez reported a case of multiple aneurysms of the retinal arteries with associated hemorrhages. The patient was 54 years of age and had general arteriosclerosis, with a systolic blood pressure of 180 millimeters of mercury. The patient died of cerebral hemorrhage forty days after the discovery of the aneurysms.

Spasm.—Amaurosis fugax, in some cases due to spasm of the retinal arteries, was listed by Moore as one of the complications of retinal arteriosclerosis. Among the first reports on the subject was that of Wagenmann. Spasm can occur in conditions other than hypertension and arteriosclerosis, notably in Raynaud's disease, as has been pointed out by myself and Gipner, Aubaret and Sédan, and by Mylius who also observed them in polycythemia. Knapp stated that intermittent closing of the retinal arteries, due to spasm, may occur in normal or in diseased vessels. In healthy retinal arteries, intermittent closing may occur without any lasting effect on vision. In diseased retinal vessels it is of grave significance for sight. He also noted that Osler mentioned the direct incentive to spasm offered by pathologic changes in

the vessels. Recently emphasis has been laid, especially by Volhard and Mylius, on the significance of spasm of the retinal arteries in the production of sclerosis and retinitis. Aubaret and Sédan stated that spasm of the retinal arteries can result in the "retinite capillarospastique" of Horniker, fine hemorrhagic and exudative lesions at the posterior pole and especially at the macula, which is often associated with angina pectoris.

Hemorrhages.—Hemorrhages in the retina in association with retinal arteriosclerosis, as distinct from retinitis and venous thrombosis, belong, as Lange and Lange have pointed out, to the picture of hypertension and not to that of general arteriosclerosis. A current belief, as Norris expressed it, was: "The presence of retinal hemorrhages in a case of chronic arterial hypertension points almost indubitably to severe nephritis." I was able to show that in the majority of such cases, renal function is adequate. According to Rohmer, Artigalas stated that retinal hemorrhage without traumatism is always the result of a lesion common to the arteries of the brain and is always followed by cerebral hemorrhage, if the degenerative process continues. Geis expressed it somewhat more conservatively when he said that retinal hemorrhages in arteriosclerosis are usually forerunners of cerebral hemorrhages, or more rarely softenings, but that these may be delayed for years and that the prognosis for life need not be unfavorable. Pines stated that retinal hemorrhage is always a serious and temporary warning, although it does not always mean immediate danger. The opinion of Moore more nearly fits all the facts. He said: "Retinal hemorrhages are incidental to the arterial disease and their presence in general does not convey any special significance; in some cases, however, an increase in their number precedes the onset of serious symptoms."

The hemorrhages in such cases are probably due to disease of the venous or capillary walls. Gunn thought that, as a result of the long-continued constriction of the arteries, edema of the retina occurs and renders the walls of the capillaries and veins more permeable so that diapedesis of blood cells takes place. Coats believed that hemorrhage occurred, not at the site of sclerosis in the artery, but as a result of obstruction to the circulation, in some unthickened part, as in the capillaries. Bailliart stated that local hypertension in the retinal arteries can cause hemorrhage, through its effect on the capillaries and veins.

Venous Thrombosis.—As pointed out by many authors, such as Coats, Geis, Moore, Lerner, Kress and Lancaster, the chief cause of thrombosis of the retinal veins is angiosclerosis. A few cases are the result of primary phlebitis, but the phlebitis or phlebosclerosis, as Moore and Lancaster have stated, is usually the result of pressure of a sclerosed artery. Coats believed, and apparently correctly, that thrombosis of the

central vein of the retina per se affords little information with regard to the prognosis for the life of the patient and that the prognosis depends on the general factors in the case. According to Geis, venous thrombosis in only from 40 to 50 per cent is a forerunner of cerebral arteriosclerosis which may lead after several years to apoplexy, and it is diagnostic of cerebral arteriosclerosis only when there is demonstrable retinal arteriosclerosis. Moore stated that the prognosis for life is less serious with venous than with arterial disease. Of thirty-six of his patients, fifteen (41 per cent) had suffered with a gross cerebral vascular lesion for eight years; the average duration of life was five and eight-tenths years.

Arteriosclerotic Retinitis.—Moore's description of the retinitis of arteriosclerosis is the only one thus far available. He has established it as a clinical entity, due, he believes, to local arterial disease and not to renal factors. It is characterized by the addition, to sclerosis of the retinal arteries, of hemorrhages and of bright white spots or dots of exudate without evidence of surrounding edema. These spots are represented histologically by hyaline masses in the internuclear layer of the retina. In his group of patients with arteriosclerotic retinitis, the blood pressure was higher, the incidence of cerebral vascular lesions was more common and the mortality was greater than in the group with arteriosclerosis alone. Their tenure of life, he stated, is uncertain, although they may live a number of years; they usually die of cerebral hemorrhage or cardiac failure. Thus sixteen of his thirty-one patients with arteriosclerotic retinitis died after the same length of time as eight of thirty-five patients with retinal arteriosclerosis only.

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News and Notes

EDITED BY DR. JOHN HERBERT WAITE

GENERAL NEWS

Association for Research in Ophthalmology.—The following tentative program has been arranged by the Association for its meeting at Detroit, June 24, 1930. Etiology of Acute Iritis: Review of the Literature on the Etiology of Acute Iritis, by Dr. Sanford Gifford, Omaha; Syphilis in the Etiology of Acute Iritis, by Dr. J. Earle Moore, Baltimore; Tuberculosis in the Etiology of Acute Iritis, by Dr. William C. Finnoff, Denver; Endogenous Infections in the Etiology of Acute Iritis, by Dr. Lewellys Barker, Baltimore; Immunology and Bacteriology in the Etiology of Acute Iritis, by Dr. John A. Kolmer, Philadelphia, and Evaluation of Etiologic Factors in Acute Iritis, by Dr. Thomas B. Holloway, Philadelphia.

Medical Motion Pictures.—Convinced of the value of motion pictures as a supplementary aid in the teaching of medicine and surgery, the American College of Surgeons is cooperating with the Eastman Teaching Films, Inc., Rochester, N. Y., in the production of films of interest and of scientific accuracy. An inquiry to Rochester will yield a pamphlet describing the medical films now available and indicating the medical film library now in the process of creation.

Of ophthalmologic interest, one of the films to be released early will deal with tests for vestibular function, with animation showing nystagmus. The film opens with animated drawings, showing the nervous connection between the semicircular canals and the extrinsic muscles of the eyes, and then the results of nervous impulses generated through the flow of endolymph. The rest of the film demonstrates correct methods of performing the tests and the normal responses to be expected.

Abstracts from Current Literature

EDITED BY DR. WILLIAM ZENTMAYER

Physiology

A REVIEW OF THE PULSE WAVES OF THE HUMAN EYE. W. WEGNER, Arch. f. Augenh. **102:** 1, 1929.

The author points out that at normal intra-ocular pressure the pulsations are slight, but that as the pressure inside the eye is raised these pulsations increase in amplitude until a point is reached at which the intra-ocular pressure prevents the access of blood into the eye. The same effect can be produced by enclosing the eye in an airtight capsule and increasing the atmospheric pressure in this capsule.

The author has done this with an apparatus which he describes in detail. Simultaneous records of the carotid pulse and the pulsations in the globe are given. The plethysmograms so obtained are the result of two factors: (1) a protrusion of the whole globe by the extra-ocular orbital circulation and (2) pulsations of the eyeball itself.

In order to differentiate between these two, the author took records from an orbit from which the eye had been enucleated. This showed that at least part of the curve was due to the pulsations of the globe itself. By this method, he obtained values of the systolic blood pressure in the ophthalmic artery of 90 millimeters of mercury, systolic, and from 55 to 60, diastolic.

F. H. ADLER.

Congenital Anomalies

THE "HETEROTYPICAL" CONUS (WITH SPECIAL REFERENCE TO THE CONUS INFERIOR) AND THE ECTASIA OF THE ADJOINING PART OF THE FUNDUS: CLINICAL STUDIES. A. BEELER, Arch. f. Ophth. **122:** 343 (July) 1929.

By "heterotypical" conus, the author means any kind of conus except the ordinary temporal conus. He studied thirty-five patients who showed this heterotypical conus. Twenty-seven had the conus in both eyes, seven only unilaterally. Forty-seven per cent of all the eyes with heterotypical conus had an astigmatism of from 1.25 to 3 diopters. The visual acuity was nearly always considerably reduced. In cases of unilateral heterotypical conus this eye was always amblyopic. The plane of the entrance of the optic nerve was frequently found to be oblique, the upper margin of the disk projecting above the plane of the adjoining fundus, the upper vessels being slightly tortuous. In thirty-one cases the area next to the heterotypical conus was slightly ectatic and less pigmented than the other sectors of the fundus. If the ectasia extended into the macula region too the macula reflex became irregular. In spite of the variations of the location of the conus the author believes that all these coni are connected with the fetal cleft. Another relation seems to exist between the astigmatism and the heterotypical conus. Both must be considered as hereditary anomalies of the growth of the eyeball.

P. KRONFELD.

Vision

DEFECTIVE SIGHT AND SIGHT EDUCATION. K. R. SMITH, Brit. J. Ophth. **14:** 16 (Jan.) 1930.

The author states that, in classification, concomitant strabismus finds its true place among disorders of the brain. The movements of the eye to fix the object seen are a natural response to the stimulus that induces the sensation of it on the eye that sees it, and can be obtained in no other way than by bringing about the sensation. Sensation with both eyes simultaneously similarly brings about fixation by both eyes simultaneously, each by its own sensation. The sensation of object attracts attention and awakens the desire to see it with the clearest vision, and the eye is moved so that the retinal image of the object falls on the punctus centralis to attain this clearest vision.

One begins life with each eye a separate alternative doorway to our clearest sense of sight. From this infantile vision, the higher type of adult sight, binocular vision, develops by education. The failure to educate sight to its normal condition of perfectly spontaneous binocular vision constitutes by far the most common defect of vision. There is abundant evidence that natural education of sight under civilized conditions needs rational help. The facts point clearly to the failure in the power to retain simultaneous vision with both eyes for near work in the early years of life, and as clearly show the necessity for training to attain stability in simultaneous vision with both eyes during these early years. Provided that the natural use of both eyes is thus assured, it appears probable that the ordinary use of them will complete the education.

W. ZENTMAYER.

Refraction and Accommodation

TELESCOPIC SPECTACLES. A. H. LEVY, Brit. J. Ophth. **13:** 593 (Dec.) 1929.

This article treats of the optical principle involved and the practical application of telescopic lenses. The subject of aberration of lenses is discussed. It is pointed out that telescopic lenses formerly recommended only in excessive myopia are now being used by patients who are approximately emmetropic but who have poor vision. The necessity for providing separate spectacles for reading and for distance vision is explained.

W. ZENTMAYER.

HEREDITY AND THE MYOPIC DEGENERATIONS IN THE FUNDUS. E. VONTOBEL, Arch. f. Ophth. **122:** 311 (July) 1929.

Vogt has put forth the theory that the senile as well as the myopic degenerations in the eyeground are of hereditary origin. In this paper the author tries to prove this theory by studying families with extremely mild or severe degrees of myopic degeneration of the eyeground. He examined five families consisting of twenty-two persons. In these families the myopic degenerations were very marked, although the degree of myopia was not high. On the other hand, the author could find six families, which included twenty-one persons, who in spite of a very high myopia had only slight myopic degenerations. Among the

members of these two groups of families, the intensity and the extent of changes were always about the same. In a third group of patients, a certain amount of variations was found. Among members of the same family, some had severe and some had only slight degenerative changes. The author thinks that this amount of variability fits in with the laws of heredity. He concludes that the myopic degeneration of the fundus must be considered as a quality which is mainly determined by heredity.

P. KRONFELD.

Methods of Examination

PRINCIPLES APPLIED IN USE OF CROSS CYLINDERS. E. JACKSON, Am. J. Ophth. **12**: 897 (Nov.) 1929.

The author gives a brief history of astigmatism and the development and rationale of the cross cylinder. He makes a plea for its use as a means of determining the direction rather than the amount of astigmatism. The principle of its use is the same as in turning a cylinder in a trial frame except that the cross cylinder is better in that the changes are exaggerated and sudden, and thus allow the patient to recognize them more easily.

W. S. REESE.

APPLICATIONS OF MY CENTESIMAL LUMINOUS OPTOMETER. E. RICCI, Ann. di ottal. e clin. ocul. **57**:688 (Aug.-Sept.) 1929.

The author's instrument, which was described in 1923, embodies the principles of the Claasson instrument familiar to Americans, employing the projection of optotypes by a movable lantern to give images which may be varied in size by very fine gradations. Thus the recording of vision may be made exact to within $\frac{1}{100}$ or less, and a centesimal scale is employed. The optical device by which the lantern is made to focus at all distances is described. The value of such an instrument in determining the progress of a case is obvious, and the method of determining and correcting astigmatism by its use is described. By a series of screens, the instrument may be used as an adaptometer for recording the light sense. Malingering may often be detected, since the patient has no means of making different visual records coincide. Differences of more than $\frac{6}{100}$ gives evidence of simulation. The test with colored glasses is also conveniently employed with this instrument, since a colored filter may be added without the patient's knowledge.

S. R. GIFFORD.

Experimental Pathology

THE INFLUENCE OF ENDOCRINAL GLAND EXTRACTS ON THE REGENERATION OF THE AQUEOUS. A. CAR and H. ORTYNSKI, Arch. f. Ophth. **122**: 240 (July) 1929.

The regeneration of the aqueous was studied by comparing the refractive index and the protein content of the aqueous and of the regenerated fluid which is found thirty minutes after the puncture of the anterior chamber. Normally, this regenerated fluid contains from 2.5 to 3.2 per cent of protein. Subconjunctival injections of cocaine and a local anesthetic, *di*-allyloxyethyl-*di*-phenyl amidine hydrochloride, had

no influence on the composition of the regenerated fluid. Two-tenths cubic centimeter of a preparation made from the posterior lobe of the pituitary gland, injected under the conjunctiva, decreased the protein content of the second aqueous considerably (down to 0.6 to 1 per cent). This preparation had very little visible influence on the vessels of the conjunctiva and did not alter the width of the pupil. No details are given about the preparation—nor its general pharmacologic qualities. The author believes that it influences the "osmotic and the secretory factor of the reformation of the aqueous." An extract of the parathyroid glands behaved like the posterior lobe preparation in cutting down the protein content of the second aqueous. Insulin acts in a similar way. Thyroid, thymus, testis and ovary extracts had no perceptible influence.

P. KRONFELD.

EXPERIMENTAL STUDIES OF THE CHANGES IN NORMAL EYES AFTER EXPOSURE TO X-RAYS. THIRD PART: CHANGES IN THE LENS, THE RETINA AND THE OPTIC NERVE. W. ROHRSCHNEIDER, Arch. f. Ophth. **122**: 282 (July) 1929.

The author reviews the literature on roentgen changes of the eye very extensively. His own experiments comprised twelve rabbits, the eyes of which he exposed to from 170 to 360 per cent, or the human erythema dose. In every case changes in the lenses were observed. The first stages, which could only be seen histologically, showed swelling of single lens fibers and formation of a pseudo-epithelium. The changes were mainly confined to the posterior cortex, without any sharp limits toward the anterior part of the lens. There was no similarity between this experimental roentgen cataract and the glass blower cataract. The shortest time between the exposure and the appearance of the first changes in the lens was ninety-three days. The author thinks that under the circumstances of his experiments the cataract was due to a direct effect of the rays on the lens. No changes were found in the optic nerve or in the retina.

P. KRONFELD.

INSULIN AND OCULAR TENSION: OBSERVATIONS ON NORMAL PERSONS, DIABETIC PERSONS AND PATIENTS WITH GLAUCOMA. J. D. E. VESTERGAARD, Acta ophth. **7**:273, 1929.

By injecting 12 units of "Leo" insulin intravenously into normal subjects, Vestergaard was able to show an average fall of intra-ocular tension of 3.2 mm. or 17.5 per cent of the original mean tension. The decrease began about from ten to twenty minutes after the injection, and the lowest pressure was generally reached before the amount of blood sugar had diminished to its minimum. After an average lapse of sixty-five minutes, the intra-ocular tension reached its normal value again. In diabetic persons, the alteration of the intra-ocular tension was not very marked. In glaucoma, there was a fall in the intra-ocular tension of almost 30 per cent within from fifteen to thirty-five minutes following the intravenous injection of the insulin; the tension remained constant or ascended very slowly for at least five hours. Injections of epinephrine intravenously produced a decrease of intra-ocular tension. The reaction was apparently of the same type as that produced by insulin. Hypophysin also lowered the intra-ocular tension.

A. M. YUDKIN.

Trachoma

A New Operation for Trachomatous Pannus. E. Moretti, Ann. di ottal. e clin. ocul. **57**:677 (Aug.-Sept.) 1929.

The author's operation is designed to produce a more permanent obliteration of the vessels than is accomplished by peritomy, without the disadvantages of peridectomy, cauterization, etc. It consists in a close chain suture starting 2 mm. from the limbus at 3 o'clock and extending around the upper half of the cornea to a similar point at 9 o'clock. The stitches are placed 1.5 mm. apart, each one including the whole thickness of the conjunctiva and the vessels supplying the pannus, and when all are drawn tight, the vessels are obliterated. No. 0 catgut is used and left to absorb. Seven cases are reported in all of which vision increased from counting fingers at 1 or 2 meters to from $\frac{5}{50}$ to $\frac{5}{20}$. With the slit-lamp, the complete obliteration of the superficial vessels in the upper half of the cornea could be observed. (Bibliography.)

S. R. Gifford.

Cornea and Sclera

Peripheral Pigmentation of the Cornea Associated with Lenticular Degeneration of the Pseudosclerosis Type. T. B. Holloway and P. De Long, Am. J. Ophth. **12**:871 (Nov.) 1929.

A Russian woman, aged 34, was admitted to the Philadelphia General Hospital in April, 1915, complaining of generalized tremor. Six months previously she had been badly frightened, shortly after which she was seized with attacks of trembling involving the entire body. These attacks increased in frequency and duration until at the time of admission the tremor was almost constant. Physical examination revealed a well developed and nourished, white adult with slightly subnormal mentality. On the slightest mental or physical effort, she showed coarse, clonic tremors of the head, trunk, arms and legs. This tremor was proximal rather than distal, involving the elbows and knees rather than the fingers and toes. When walking, the patient had a tendency to lean forward, and there were backward and forward motions of her head, and at times of her trunk, with a coarse tremor of one arm and then the other, and sometimes of both. Her condition grew progressively worse, and the tremor became so violent that walking was impossible. Speech became hesitant and more or less explosive, but not scanning. The blood chemistry and colloidal gold curve were normal and the Wassermann reaction of the blood and spinal fluid was negative.

With the naked eye, a greenish-brown or smoky discoloration could be seen at the limbus of each eye. With the Zeiss loupe, this discoloration appeared as smoky crescents above and below, extending in the right eye from 10:30 to 2 o'clock, and from 4 to 8:30; and in the left eye from 9:30 to 2, and from 4 to 8:30 o'clock. Its greatest width of about 2 mm. was in the vertical meridian. Slit-lamp examination revealed that the pigmentation involved Descemet's membrane, and was of a greenish tinge. It was not profuse, did not extend to the angle and faded out toward the pupil.

The authors review the literature and discuss the pigmentation of the cornea, and suggest that in the future a thorough histologic and chemical examination be made of the internal organs, especially of the liver and kidneys.

W. S. REESE.

PATHOLOGICAL DIMPLES ("DELLEN") OF THE CORNEA. A FUCHS, Am. J. Ophth. **12**: 877 (Nov.) 1929.

These were first described by E. Fuchs as shallow, saucer-like excavations at the margin of the cornea with clearly defined, buffed edges, steep in the cornea and flat in the limbus. They are usually at the temporal margin and their floor exhibits a faint opacity with a silvery and slightly warty reflex. The corneal sensibility within the dimple is diminished. These dimples cause little disturbance outside of some burning for several hours. The causes are: (1) swelling of the limbus with the episcleral tissue (in episcleritis), scleritis fugax, suffusion, angioma, a thick pinguecula, after advancement of a rectus muscle or after a subconjunctival injection; (2) administration of cocaine; (3) operation for cataract; (4) hemeralopia; (5) paralytic lagophthalmos; (6) spontaneous, without known cause, in otherwise normal eyes of old people.

The author states that the most striking symptom of the dimple is often a shadow seen with focal illumination at the lower part of the iris. This shadow of the dimple is very obvious with a light iris. He cites several cases, one of which he was able to section, because of an intra-ocular tumor. A complete description of this case is given, the essential pathology of the dimple being a thinning of the epithelium. The possible causes are discussed, the author apparently inclining to compression of the adjacent limbal vessels which causes reduction in the blood supply of the superficial corneal layers.

W. S. REESE.

AN UNUSUAL CASE OF CORNEAL DISEASE. F. A. WILLIAMSON-NOBLE, Brit. J. Ophth. **13**: 572 (Nov.) 1929.

The patient, a woman, aged 44, was first seen in October, 1924, as having an error of refraction. The glass selected under cycloplegic was: right eye, +1.0 diopter sphere +1.0 diopter cylinder 180 degrees 6/9; left eye, + 1.5 diopter sphere + 1.0 diopter cylinder 180 degrees, 6/6 partly. In April, 1927, she complained of seeing a mist now and again with the left eye. No changes were found. Vision and refraction were unchanged. In November, 1927, she complained of seeing a spider web about lights with the left eye. Vision equaled 6/18 with correction. The biomicroscope showed a slight opacity occupying the pupillary area in the posterior third of the cornea. There was no evidence of inflammation. The following explanations for the condition were considered: endocrine disturbance; a deficiency disease analogous to keratomalacia; a defect in calcium metabolism. Treatment along these lines was instituted both for the condition itself and to prevent its occurrence in the right eye. Despite this, in January, 1929, a star-shaped pigmented area had developed in the anterior layers of the cornea, and a wrinkle had appeared in Descemet's membrane, the opacity being unchanged. The refraction was now +9.0 diopters sphere

+1.0 cylinder 60 degrees 6/12+. The change in the refraction is explained by a flattening of the cornea.

The interest of the case, the author concludes, lies in the following points:

1. The development of an opacity in the posterior layers of the left cornea unattended by any inflammatory reaction.

2. The restriction of this opacity to the cornea of one eye only; whether this was due to the treatment adopted, it is not, of course, possible to say.

3. The subsequent development of 8 diopters of hyperopia, with an alteration of 60 degrees in the axis of the astigmatism.

W. ZENTMAYER.

XANTHOMATOSIS OF THE CORNEA AND SCLERA. W. GILBERT, Arch. f. Augenh. **100-101:** 329, 1929.

The author gives the bibliography and a short description of cases of xanthomatosis reported in the literature. In these cases the iris, chorioid and anterior chamber were chiefly affected. A case is then reported in which the cornea and sclera were chiefly affected. The blood showed a high cholesterol content, from which the author concludes that the disease is due to a deposition of fat from the circulation.

F. H. ADLER.

Lens

INTRACAPSULAR EXTRACTION OF CATARACT. A. J. MANES, Arch. de oftal. de Buenos Aires **4:** 426 (July) 1929.

In this paper the author reports the results of 150 cases of intracapsular extraction, performed according to the Staculeano-Torok method such as is practiced at Elschnig's Clinic in Prague.

After detailing the different preoperative steps and precautions, to which he attaches great importance, the method of anesthesia followed, with dilatation of the pupil and an akinesia and retrobulbar injection of procaine hydrochloride, then a preliminary suture of the superior rectus was made to keep the eye open and immobilized. The author proceeds to describe the operation, which consists in making a large conjunctival flap, with application of a conjunctival suture, to be tied later; a peripheric iridectomy or iridotomy; luxation of the cataract with Elschnig's forceps applied to the inferior pole; the expulsion of the cataract being effected by means of the forceps and pressure with a squint hook applied to the lower corneal margin. This is followed by an immediate tying of the suture, the iris being reduced when necessary by means of delicate massage.

He obtained an intracapsular extraction in 112 of 150 cases. In two cases, the lens sunk into the vitreous; in twenty-three cases, there was choroidal detachment; in twenty-four there was ectopia pupillae. There were no posterior retinal detachments. In only 10 cases was an iridectomy necessary.

The author operated in twelve cases of complicated cataract, performing a capsular extraction on all but two eyes; in one case, that of a woman with choroidal cataract, he performed an intracapsular extraction obtaining useful vision.

C. E. FINLAY.

THE FREQUENCY AND LOCALIZATION OF LENS OPACITIES IN CHINESE OBSERVED BY SLIT-LAMP EXAMINATION. C. H. CHOU, Nat. M. J. China **15**:573 (Oct.) 1929.

Chou examined a series of 312 eyes with the binocular corneal microscope and found coronary cataract in 105 eyes, or 33.65 per cent. In 17.95 per cent of the cases the condition was of a mild grade, in 8.65 per cent of moderate grade and in 7.05 per cent it was well advanced. Anterior axial embryonic cataract (Vogt) was found in twenty-eight eyes (8.97 per cent). Cataracta centralis pulverulenta occurred twice, affecting four eyes. Punctate cataract in front of the juvenile nuclear surface was found in both eyes of one person. Atypical posterior cortical cataract occurred once in both eyes of one person.

S. H. McKEE.

Glaucoma

THE ADRENALIN PACK IN THE TREATMENT OF GLAUCOMA. R. E. WRIGHT and K. KOMAN NAYAR, Brit. M. J. **2**:456 (Sept. 7) 1929.

The authors discuss the following three newer nonoperative aids to treatment: (1) glaucosan of Hamburger, an epinephrine substitute; (2) intravenous injection of hypertonic sodium chloride solution (30 per cent) as described by Duke-Elder, and (3) the epinephrine pack, originally advocated by Gradle and favorably reported on by S. R. Gifford and others.

With regard to the first, the authors agree with the unfavorable conclusions of Duke-Elder and Law. The intravenous injection of sodium chloride was serviceable only as an emergency measure in cases of acute intractable glaucoma as a preliminary procedure to an emergency iridectomy. The third measure, however, has proved both a simple and expeditious aid to treatment. The authors insist that the best single nonoperative method of treatment is the efficient instillation of physostigmine (eserine), and that no combination of nonoperative measures obviates eventual operative treatment by decompression, and that trephining is the best means to accomplish this. The epinephrine pack is of the greatest use in chronic primary glaucoma, where it is a powerful adjunct to other nonoperative treatment, to give physostigmine a start, as it were. It can be repeated five or six times at short intervals, and is now generally used in cases in which the ordinary nonoperative treatment was ineffective and it was desirable to get the eye in a more favorable state for operation.

The eye is anesthetized with 2 or 3 drops of 2 per cent holocaine. The tension is then taken. To obviate the initial rise of tension due to the epinephrine, physostigmine should be given before and after the pack, say six instillations in the hour before, and then six instillations at intervals of one-half hour. A small, flattened pledget of cotton is soaked in epinephrine solution (1:1,000, Parke, Davis & Co.), and while the patient looks down and the lid is reflected with a retractor, it is placed in the upper fornix, and the lids are closed. It is left there for five minutes. A marked rise in tension does not lead to any untoward result; the tension falls on the next day. In badly damaged eyes, with excessive tensions, startling effects in reduction of tension were observed. Charts of six cases are added.

A. KNAPP.

Retina; Optic Nerve

THE CAUSE AND RESULTS OF OBSTRUCTION OF THE CENTRAL ARTERY OF THE RETINA: A STUDY OF ELEVEN CASES. H. V. COVERDALE, Brit. J. Ophth. 13:529 (Nov.) 1929.

After a statement as to the processes which may be responsible for acute obstruction and as to the limited value of reported cases for statistical purposes, the author deduces the following facts from an analysis of fifty-one cases in literature and eleven of his own: 1. The two sexes are about equally affected. 2. In young adults, the condition is more common in females and in later life, in males. 3. It is as common in young adults as in later life. The analysis of his eleven cases as to physical condition shows mitral disease in four, mitral and aortic disease in two, aortic disease in two, and no evidence of cardiac abnormality in three. From this, he concludes that the large proportion with endocarditis points to embolism as the cause. Six of the cases illustrate the blood supply to the macula. It appears that the macula may be supplied by a twig from the main artery, a cilioretinal artery or a branch from the superior or inferior temporal artery; in part, by any of the foregoing sources. A cilioretinal artery can be present without supplying the macula. The eleven cases are reported in detail, with drawings of the fundus, together with sketches of the vessels on the disk and field graphs.

The following conclusions are drawn:

Cause.—1. While obstruction in later life may reasonably be interpreted on clinical and pathologic grounds as a consequence of endarteritis, as explained by Coats, the most satisfactory explanation of the great majority of cases, not definitely so attributable, is embolism.

2. There is evidence that embolism may occur in the absence of any other signs of cardiovascular disease.

3. There is evidence that emboli, when arrested, do not lead to early thrombosis, and may subsequently become detached and pass further along the vessel, with or without causing permanent damage to the retina. Also, that they may cause only partial obstruction.

Results.—Arteries: While the ultimate reduction in size of affected arteries may, in some cases, be due to a process of accommodation resulting from diminished circulation, there is evidence that in others it is due to the obstruction affecting the nutrition of the walls, followed by degenerative changes.

Retina: The retinal pallor is a combination of two processes: (1) edema, lasting one to two weeks and (2) necrosis of the inner layers of the retina, commencing after and lasting longer than the edema.

In cases of temporary obstruction of short duration, the former only may occur.

Visual Field: While Coats' observation that the retained field in complete obstruction is situated around the nerve head is confirmed, there is evidence that some field may occasionally be retained at the periphery. The character of any retained field depends on a combination of the duration, the degree and the position of the obstruction, and on the effectiveness of any cilioretinal circulation or anastomoses. A central scotoma is evidence of a central obstruction of duration

between, approximately, one and five and one-half hours, and is due to macular anemia.

Vision: The macula, owing chiefly to precarious vascular supply, is the most vulnerable region in retinal artery obstruction, but, if the duration of the obstruction is short or if there is some healthy circulation in the immediate neighborhood, restoration of some central vision may occur.

W. ZENTMAYER.

TREATMENT OF DETACHMENT OF THE RETINA. H. ARRUGA, Arch. de oftal. hispano am. **29**: 346 (Oct.) 1929.

The author begins by referring to nonuse by the majority of ophthalmologists of modern technic in the treatment of retinal detachment, notwithstanding the more satisfactory results thereby obtained in a large proportion of cases. In this paper he reports his personal experience with Gonin's method, learned from Gonin himself at Lausanne.

The following is the technic employed: After dilatation of the pupil with atropine, a preliminary search is made for the retinal rupture or ruptures present. This is often difficult, necessitating at times a prior recumbency of the patient for twenty-four hours and at others a prior drawing off of the subretinal effusion with a hypodermic needle. Once found, the site of the rupture is accurately localized in relation to the corneal meridian and distance from the corneal margin in millimeters or from the posterior pole in disk diameters.

After this localization, the operation is carried out as follows: After a superficial cocaine-epinephrine and a subconjunctival procaine hydrochloride anesthesia, a conjunctival incision, from 6 to 8 mm. in length, parallel to the corneal margin, is made over the site of the rupture, and the sclera is laid bare, any eye muscle that may be in the way being drawn aside with a squint hook. A radial incision, from 5 to 6 mm. in length, is then made in the sclera with a Graefe knife, through which a cautery point is introduced to a depth of from 3 to 4 mm., and set glowing for a few seconds; usually a small amount of vitreous is lost. The wound is then closed and the patient is kept in a recumbent position for from five to six days.

The eye may be examined after from two to three days, but no conclusion can be made in regard to the final result till after several days. In the favorable cases the detached retina reacquires its normal red color, with a reestablishment of vision and normal tension, the cauterized spot appearing ophthalmoscopically as a white patch somewhat larger than the disk, surrounded by a black margin of more or less abundant retinal pigment. There is no relation between the site of the rupture and that of the detached retina.

In favorable cases, when the closure of the rupture is obtained, the subretinal effusion, even if situated elsewhere, is rapidly absorbed. When the occlusion is incomplete, the final result is not so good. In cases in which the result has not been satisfactory or in which the rupture has not been localized, the author employs Lagrange's "colmatage" (subconjunctival cauterization of the sclerotic in two sessions) or Sourdille's puncture of the subretinal fluid and a subconjunctival injection of cyanide of mercury over the puncture area, these measures usually proving unsuccessful.

The author next describes in great detail the different types of rupture, which he illustrates with twenty-five beautifully colored ophthalmoscopic plates. The most favorable cases for treatment are those of recent origin, in which the rupture is correctly localized. Only cases of traumatic or spontaneous origin are amenable to this treatment, detachments produced by intra-ocular tumors not being, of course, thus treatable.

The author next reports thirty-three cases, which he classifies into three groups: fifteen easy cases, eleven difficult and seven very difficult cases.

In the first group seven patients recovered after a first cauterization, with vision above 0.4; two with vision between 0.4 and 0.1, and one with fingers at 1 m.; relapse occurred in three cases, one patient was reoperated on and a vision of 0.6 was finally obtained, and in the other two cases it was reduced.

In the second group, excellent results were obtained in two cases with a vision above 0.4; four with vision between 0.2 and fingers at 1 m.; in five cases vision was lost. Gonin's operation was performed in eight cases and Sourdille's in three; some patients were operated on several times.

In the third group, he obtained a satisfactory result in only one case; in four, he performed Lagrange's colmatage, and in three, Sourdille's operation.

The author concludes in accordance with Gonin, that in the great majority of cases one or more retinal ruptures can be determined; that if the closure of the rupture is obtained, the retina rapidly adapts itself to the choroid; when this does not occur the adaptation of the retina or the cure of the detachment does not take place. The greatest difficulty lies in the finding of the rupture or ruptures and in their correct localization.

The easy cases are recent ones, with ruptures of from 1 to 2 disk diameters situated in front of the equator and which have not previously been submitted to other active treatments. Cure is obtained in 50 per cent of the cases.

The difficult cases are those of over two months' duration with large or multiple ruptures; those in which the rupture is situated posterior to the equator; those previously submitted to irritative treatments; relapsing cases and those accompanied by extensive chorioretinal disease. Cure is obtained in 10 per cent of the cases.

The very difficult cases or those theoretically unadapted to this method are those in which the rupture is not found; those in which it is very large and those in which it is situated at the macula or its neighborhood and is not accessible. In such conditions, a cure of the detachment is exceptional.

C. E. FINLAY.

THE MECHANISM OF RETINAL DETACHMENT: THE PHYSICOCHEMICAL QUALITIES OF THE VITREOUS BODY. M. BAURMANN, Arch. f. Ophth. **122**: 415 (July) 1929.

This paper brings new and extensive studies of the physicochemical qualities of the vitreous. Special attention is paid to the question of how changes of the volume of the vitreous can occur and be produced

experimentally. It is found that as low a pressure as 1 mm. of water is sufficient to squeeze some water out of the vitreous. Shrinking of the vitreous can be produced by extreme variations of the p_H of the surrounding medium, variations of an extent that never occur intra vitam. Chemical agents do not alter the volume of the vitreous unless the p_H is changed too. The author objects to the theory that retinal detachment can be caused by a shrinking process of the vitreous. On the other hand, the vitreous must not be thought to be one of the factors that keeps the retina in its normal position. The author believes that there is a difference of pressure in the preretinal and in the retroretinal space. A sudden drop of the capillary pressure in the preretinal space or an increase of the capillary pressure in the retroretinal space should cause a retinal detachment. The same thing should occur if the walls of the capillaries of the choroid became permeable to proteins. In this case the colloidal osmotic pressure behind the retina would be higher than that in front of it.

The author compares the anatomic changes in eight cases of retinal detachment with his theoretical conceptions. The shape of the detachment never corresponds to the postulates of the theory of retraction of the retina. The shape of the detachment can always be explained by simple pressure from the retroretinal space. From his eight anatomic cases the author concludes that the detachment is due to an excess of pressure behind the retina (either exudate or hemorrhage). The tears or holes which are so frequently found are only secondary symptoms. They have nothing to do with the primary development of the retina. But it must be admitted that they prevent the reattachment of the retina.

The detachments which occur after cataract extractions and after extractions of clear lenses in persons with myopia are not more frequent in cases in which a considerable amount of vitreous is lost. In all these postoperative detachments the author assumes inflammatory processes in the choroid as the cause of the detachment. His opinion may thus be summarized:

1. The primary cause of the detachment is a disturbance of the equilibrium of pressure in front and behind the retina. Most of these disturbances are the result of an exudative choroiditis.

2. If the retina is detached, ruptures and tears appear which prevent the reattachment.

3. The vitreous plays only a passive rôle.

P. KRONFELD.

THE ANATOMY AND PATHOLOGY OF DISCOID DEGENERATION OF THE POSTERIOR OCULAR POLE. CARL BEHR, Ztschr. f. Augenh. **69**:1, 1929.

Behr describes in detail the histopathologic observations on an eye which was enucleated from a patient, aged 83, because of the presence of a mass which was diagnosed clinically as sarcoma. He found, however, that the elevation of the retina was produced by a degenerative condition of the surrounding ocular tissue. The picture was therefore that of discoid degeneration of the macula. From his study of the tissue he noted that the degeneration was produced primarily by a senile change in the elastic membrane. The alteration may be considered in the light of senile involution or sclerosis accompanied by metabolic

disturbances produced by changes in the tissue fluid which entered the area. The other tissue changes noted were probably secondary. He assumes that the macular area is more prone to this sort of disturbance because of its more copious vascular supply. A. M. YUDKIN.

ANGIOPATHIA RETINAE TRAUMATICA (O. PURTSCHER). C. H. CHOU, Nat. M. J. China **15**:592 (Oct.) 1929.

This rare and interesting eye disease, first described by O. Purtscher in 1910, usually follows a contusion of the head and skull. The ophthalmoscopic signs consist of white cotton wool-like flakes of rather indistinct outlines and of various sizes and shapes, which measure from about 1/5 to 1 papilla diameter. They are found chiefly near the papilla, but also in a region away from the disk along the trunks of the large retinal vessels. There may be present in the fundus thirty or more of such patches. In rare cases, as in the one here reported, these opacities became confluent and formed a continuous layer. The retinal picture may not give any alarming visual disturbance. A case has been reported by Schneider in which the condition was fully developed sixteen hours after the accident. The opaque flakes become absorbed in the course of several weeks, and may leave behind no trace of the disease. The vision in the absence of complication may become normal again.

To the few cases in the literature, Chou adds the following: A man, aged 51, was severely injured in an automobile accident by being under the bus for about fifteen minutes, with its whole weight on his abdomen and chest. Complete details of the result of the physical examination are given.

The picture was typical of traumatic asphyxia. Besides the ecchymosis of the lids, there were found in the right fundus numerous grayish white opacities of various sizes and shapes. The fundus picture remained more or less unilateral. The retinal changes disappeared in the course of three weeks. S. H. MCKEE.

Neurology

STARING ATTACKS WITH OCULAR MUSCLE SPASM AND SLEEP. K. VELHAGEN, JR., Klin. Monatsbl. f. Augenh. **83**:169 (Aug.-Sept.) 1929.

Disturbances of the ocular muscles are frequent sequelae of epidemic chronic encephalitis. Jaensch, Perkins, Sjoegren, Vampré and others have reported cases. The symptom complex described by the author is called "Schauanfaelle" in German, and "crises oculogyres" in French. Velhagen reports eight cases in which he made an examination jointly with Dr. von Stockert, who will publish the neurologic report in the *Deutsche Zeitschrift für Nervenheilkunde* under the title, "Correlation between Eye Muscles and Sleep." These eight patients suffered from lethargy or from pathologic insomnia, disturbances of the ocular muscles, querulousness, irritability and other changes of that character, and headache. The fundus and the vision were normal, except in one patient who had paralysis of the accommodation. Dysfunction of the ocular muscles was not noticed. The attacks set in without any apparent reason or psychic irritation. Fixation of an object at a close range brought them on. The globes turned upward and assumed a position of maximal convergence, the lids remained open. The spasms could

not be relaxed voluntarily and sometimes lasted for several hours. One man collapsed when told to close his eyes during the Romberg test. He dropped back and fell asleep when the test was repeated later when he was in bed. Fixation of some object, no matter where placed, caused him to tip over toward the side of the object and to fall asleep. With open eyes he was able to stand erect in a dark room but dropped to the floor as soon as they were closed. His eyes scintillated and converged on hyperventilation, inducing him to fall asleep. Two other patients developed miosis when looking at a near object for a moment, then fell asleep. (Miosis and hyperopia of 12 diopters was seen by Jaensch in a patient with emmetropia.) During the sleep, typical cataleptic symptoms were observed. After being aroused by shaking and loud calling the men remembered that they had been sleeping. Fatigue and headache followed. When looking to either side, the abduction of one eye was followed by convergence; upward spasm of both eyes set in and the lids closed. A corresponding mechanism could be noticed when the patient looked downward. Fixation for from ten to thirty seconds was sufficient to produce an attack. The spasm of convergence seemed to be the causative factor, which prisms or atropinization failed to stop. The origin remains uncertain. It is significant that similar attacks can be caused by hyperventilation, which also causes epileptic attacks. Von Stockert, therefore, concludes that, as a primary spasmotic center in the cortex causes epileptic attacks, so a primary spasm in the center of the convergence was instrumental in the cases described. Amyl nitrite produced a staring attack and deep sleep in one patient within a few seconds, just as it may bring about an attack in epileptic patients. Bell's mechanism must be considered although sleep may set in when the patient does not look upward. Hysteria may be excluded, although the severity of the attacks increases with every repetition. Suggestive and hypnotic amenability tend to indicate extrapyramidal disease. Organic disorders were present in all of these eight patients. A study of this condition is valuable for the development of the theory of sleep. The seat of the disorder must be sought in the area of the sylvian aqueduct. Some fibers springing from the ocular muscles and leading through the fifth nerve into the sleeping center may be instrumental; convergence is especially favorable for the production of sleep. The nuclei of the fifth and Mauthner's center of sleep, which are close together, may be readily attacked by encephalitis. Arteriosclerosis may be a contributing factor; syphilis and some other diseases may produce similar attacks.

K. L. Stoll.

Ocular Muscles

Nystagmus in Trauma of the Skull. R. Cords, Klin. Monatsbl.f. Augenh. **83:** 180 (Aug.-Sept.) 1929.

The author suggests a clearer differentiation of the undulating motions of the eye, oscillations and jerks. The term nystagmus should be used only collectively. Reviewing the various sources of nystagmus in injuries of the skull, the author begins with the jerks seen in lesions of the labyrinth and the vestibular nerve. He found that horizontal jerks were due, either to lesions of the brain stem or the labyrinth. The presence of the latter type can be established with certainty when the

nystagmus and vertigo disappear within a period of days or weeks. In severe lesions of the cortex, either of the optic and motor portion or the second frontal convolution, nystagmus will soon disappear and compensatory jerks, accompanying homonymous aberrations of the eyes may be observed. The latter form is horizontal and will cease simultaneously with the deviation. Meningitis, complicating fracture of the skull, causes nystagmus as soon as it becomes purulent and involves the fourth ventricle. Severe commotions of the skull through the foramen magnum may affect the brain stem; slight but protracted nystagmus may result. Nontraumatic types of nystagmus may develop as a direct or indirect sequela of an injury; they may, also, be due to lesions of the optic nerve, traumatic neurosis, hysteria, etc. Lesions of the labyrinth and frontal cortex may produce temporary nystagmus. On the other hand those of the brain stem may be accompanied by permanent nystagmus which, in severe cases, may lead to invalidity.

K. L. STOLL.

THE TRUE ORIGIN OF THE COMMON OCULOMOTOR NERVE IN THE CAT. BEAUVIEUX, Arch. d'opht. **46:** 401 (July) 1929.

In this paper, the author reports the results of an anatomic study of the third nerve nucleus in the cat. The discord in regard to this nucleus lies chiefly with the centers for constriction of the pupil and for accommodation. The occurrence of paralysis of the extrinsic muscles without involvement of the intrinsic, and visa versa suggests a definite grouping within the nucleus. The results of this study tend to support the plan described by Betcherew. In the cat, a horseshoe-shaped nucleus with an island of cells in the ring was found. No group of cells similar to the nucleus of Darkschewitz or of Edinger-Westphal was present. From the anatomic study, however, it was impossible to localize the origin of the iridociliary fibers. Only physiologic experiments and pathologic degeneration can finally solve the problem.

S. B. MARLOW.

General Disease

LEPROUS CHOROIDITIS. J. M. PENICHET, Rev. cubana de oftal. **1:**320 (Aug.) 1929.

The author reports a case of disseminate choroiditis in the atrophic stage, the development of which he had the opportunity of observing during the last two years.

He attributes a leprous origin to the lesion; the patient suffered from a "latent leprosy" and belonged to a family in which leprosy prevailed. One sister had a clear case of leprosy (with bacillary confirmation), the mother and another sister were considered as having "latent" and suspicious cases, respectively, and the father had died of leprosy. The patient herself had peculiar discolorations of the axillae, and an exacerbation of the local symptoms had been noted after injections of a solution of chaulmoogra oil. An examination of the aqueous for Hansen bacilli yielded negative results.

The Wassermann reaction was negative. No test for tuberculosis was made, but the patient, who was already in the atrophic stage was given a series of injections of tuberculin; no improvement was noted.

The report is illustrated by an excellent color plate. The clinical data and the changes in the ophthalmoscopic lesions in the several stages are admirably described and are accompanied by two charts of the visual fields.

C. E. FINLAY.

THE FREQUENCY OF DEFICIENCY DISEASES OF THE EYE DUE TO LACK OF VITAMIN "A" IN A MILITARY CAMP NORTH OF PEIPING. ARNOLD PILLAT, Nat. M. J. China **15**: 585 (Oct.) 1929.

Since the bulk of the cases of keratomalacia in adults seen in the eye clinic of the Peiping Union Medical College Hospital between January and May, 1929, were in soldiers, the writer visited a camp to see the conditions under which the soldiers lived, and to investigate the different forms of deficiency diseases and their frequency. In a military camp with 3,000 soldiers, 209 men with eye disease were examined. Of these, 91 suffered from one of the various forms of vitamin A deficiency disease of the eye.

Night blindness, pigmentation of the semilunar fold and of the fornix conjunctiva, Bitot's spots and wrinkling of bulbar conjunctiva, prexerosis of the cornea and real keratomalacia were found. Of the total number of cases of keratomalacia, 13 per cent were from deficiency diseases due to lack of vitamin A in the food. Prophylaxis by a diet of green vegetables, fat or cod liver oil would be easy. Among the 209 patients examined, it is interesting to note that 207 had trachoma.

S. H. MCKEE.

Tumors

INFORMATION CONCERNING DICTYOMA RETINAE. J. BÖCK, Ztschr. f. Augenh. **69**:17, 1929.

An enucleated eye of a girl, aged 16 years, presented a tumor mass, which seemed to originate in the unpigmented inner epithelial layer of the ciliary body. The histologic examination showed clumps of cells arranged in rosette formation, together with bands of glial tissue. Several areas of cartilaginous structure were also noted. This mass did not, however, present other gliomatous characteristics. A survey of the litererature revealed seven other similar cases in children from 1 to 8 years of age.

Böck considers this tumor mass a dictyoma, according to the description of Emanuel. He believes it to be different from growths generally originating in the ciliary body. It probably proliferates from a modification of germinal anlage.

A. M. YUDKIN.

Injuries

B. WELCHII INFECTION OF GLOBE FOLLOWING PERFORATING INJURY. W. E. HEATH, Brit. J. Ophth. **13**: 574 (Nov.) 1929.

A laborer, aged 46, was struck in the left eye by a chip of concrete. Twenty-four hours later, a small perforation of the sclera, 3 mm. from the limbus, with several small bubbles of gas, was present. During examination a fresh bubble was seen to come forward through the pupil. Seven hours later there was a marked edema of the upper lid, marked chemosis and some proptosis. A larger bubble of gas almost

filled the anterior chamber. The globe was at once eviscerated. During the operation, bubbles of gas appeared when the vitreous was scooped out. There was no pus. Twenty-five cubic centimeters of a serum prepared from *B. welchii* was given intramuscularly and 10 cc. into the orbits.

The patient made an uneventful recovery. A stab culture was made from the contents of the vitreous. From this a gas-forming organism was grown identical with the *B. welchii*, of which it appeared to be a pure culture. The bacteriologic examination was made by S. H. Browning. The few similar cases in the literature are noted.

W. ZENTMAYER.

MINOR INJURIES TO THE EYE IN INDUSTRY. B. CRIDLAND, Brit. M. J. 2:615 (Oct. 5) 1929.

There is little information about the economic effect in industry of minor injuries to the eyes. The author quotes from a report made up by four ophthalmic surgeons (of which he was one), from information obtained on 426 cases, and submitted to the council of British ophthalmologists. He concludes that minor injuries to the eye are of considerable importance, remembering especially that any minor injury may become a major one from infection. The large majority are caused by flying particles. The preventive means are: (1) mechanical guarding, (2) education of workmen and foremen and (3) engineering revision. The greatest success in prevention lies in the last, engineering revision.

A. KNAPP.

A CASE OF RETINAL EDEMA FROM AN ELECTRICAL SHOCK. H. JOURDAN, Ann. d'ocul. **166:** 725 (Sept.) 1929.

The patient was boring a hole through a thick piece of wood with an electrical drill, when the latter broke off, throwing the patient off his balance. He grasped a nearby water pipe with one hand, while with the other he held on to the broken drill, thereby receiving a shock.

He immediately noticed that his right eye was blind, but continued his work. When seen by the author, three days later, his vision was 2/10, but completely blotted out in the upper right visual field. The fundus showed an edema of the retina in the macular and perimacular regions. The disk was normal. The color fields were altered, blue being taken for green, and green for yellow. In about two months, the fields and the vision returned to normal.

The only treatment given was a few subcutaneous injections of strychnine.

H. W. SCARLETT.

Therapeutics

DIATHERMY IN DISEASES OF THE EYE. LOEFFLER AND WELLISCH, Klin. Monatsbl. f. Augenh. **83:** 285 (Aug.-Sept.) 1929.

The authors obtained favorable results in the treatment of the posterior portions of the globe by diathermy. They use Kowarschik's eye electrode, and apply doses of from 0.2 to 0.3 ampere for ten minutes, gradually increasing to twenty minutes. Thirty-one patients were treated and observed for a period of one year. Up to forty treatments

were given, either daily or every second day. The vision and the central field were improved in three of five cases of glaucoma, the type of which is not mentioned. The two failures happened in cases of chronic inflammatory glaucoma.

Improvement was obtained in some cases of retrobulbar neuritis, one of which was due to multiple sclerosis. The retardation of the failing vision in some cases of tabes is ascribed to diathermy. Positive results could be recorded in diseases of the retina and choroid and also in the absorption of opacities of the vitreous in acute inflammatory and in traumatic cases. In the case of a woman who had ruptured the wound a week after a cataract operation, dense opacities of the vitreous were distinctly diminished by twenty applications of diathermy.

K. L. STOLL.

VACCINATION AS A METHOD OF INTERFERENCE THERAPY. NIKOLAUS BLATT, Wien. klin. Wchnschr. **42**: 1255 (Sept. 26) 1929.

The author discusses the well known beneficial effect of an intercurrent acute infection on some chronic diseases and the theory of nonspecific protein therapy in general. He reports two cases in which vaccination secured a similarly beneficial effect. One was a case of severe phlyctenular keratitis and the other one of interstitial keratitis, both of which had resisted all previous treatment and cleared up rapidly following vaccination for smallpox. The author believes this form of interference therapy to be well adapted for clinical use where such therapy is indicated and warmly recommends a trial in suitable cases.

S. GIFFORD.

Blind

BLINDNESS IN OLD AGE. J. J. EVANS, Brit. M. J. 2: 847 (Nov. 9) 1929.

A classification of 700 consecutive cases certified as blindness is as follows:

	No. of cases
Cataract	205
Atrophy of optic nerves	78
Glaucoma	75
Iridocyclitis and keratitis	54
Corneal opacities	45
Retinitis pigmentosa	43
Choroidal-retinal atrophy	42
Congenital defects	33
Detachment of retina	27
Myopia	20
Phthisis bulbi	17
Choroidoretinal vascular disease	14
Diabetes	12
Ophthalmia neonatorum	9
Sympathetic ophthalmia	9
Trachoma	9
Buphthalmos	5
Injury (double), two gunshot and one explosion	3

As a number of cases of optic atrophy and choroidal diseases were ascribed to syphilis, this constitutes the chief venereal factor in the causation of blindness in old age. Modern preventive and curative treatment should undoubtedly reduce this high proportion of blindness from syphilis.

Retinitis pigmentosa amounting to over 6 per cent is disconcerting as it is the general belief that marriages of these persons is restrained. Unfortunately, many contract marriage in ignorance of their ocular trouble, and night blindness is a symptom which may not come on until later. Finally, there are those who refuse to be advised, and have no wish to count the cost to their progeny or to the state.

Of the fourteen cases of vascular disease of the choroid and retina, eleven were situated in the macular area. These, in the author's opinion, are due to the condition of the choroidal vessels. In only three cases was blindness due to retinal vascular disease.

Sympathetic ophthalmia claimed nine cases, only one of these being postoperative, the others were the result of injuries. They may be regarded as the toll of industrialism. The future holds out a definite hope that this disease may be practically eliminated and the public instructed in the gravity of ocular injuries.

A. KNAPP.

General

TOXIC ABSORPTION DUE TO FOCAL SEPTIC LESIONS: ITS EFFECTS ON THE PRODUCTION OF EYE DISEASES. A. F. MACCALLAN, Brit. M. J. 2:943 (Nov. 23) 1929.

In adults, the most usual site of focal sepsis is the mouth, while in children it is the tonsils, less frequently the intestinal tract, especially the appendix, and sometimes the colon and the duodenum, the gallbladder, the female pelvic organs, the deep urethra and prostate or any chronic form of sepsis.

Diseases of the teeth are considered under the following headings: (1) pyorrhea; (2) apical abscesses, whose frequency is not yet realized by the medical profession; (3) septic stumps of teeth; (4) buried fragments of previously extracted teeth, especially in the edentul; (5) unerupted impacted teeth, usually the third molars or upper canines, and (6) residual sepsis or bone infection, which may be indicated in a dental roentgenogram. If these conditions are present, no extraction is advised unless a dental surgeon considers it necessary on dental grounds. According to the author, gastric and duodenal ulcer and inflammation of the gallbladder or appendix are usually attributed to infections of the teeth.

The association of ocular changes with dental sepsis is not a coincidence but constant. The ocular changes may be produced by any form of focal sepsis, dental, tonsillar, sinus or intestinal, and at present the causative varieties of sepsis cannot be differentiated by the ocular effects.

There are three paths by which the products of focal infection may reach the eye: (1) direct extension, (2) lymphatic absorption and (3) deglutition of the products of tonsillar or dental sepsis and then absorption from the intestines. As examples of direct extension, the writer cites blepharitis, conjunctivitis, corneal ulcers, episcleritis, dacryocystitis and orbital cellulitis. Lymphatic absorption from closed dental sepsis,

chronic tonsillitis and chronic inflammations anywhere in the body may produce the foregoing conditions, also iritis, cyclitis, some forms of choroiditis and retinitis, closure of the central artery and thrombosis of retinal vein or one of its branches. The writer has no doubt that acquired nontraumatic cataract has its inception in focal sepsis. The effects of deglutition of septic material and its absorption from the intestinal canal may occur in any inflammation of the mouth, nose and pharynx, and the ocular lesions are the same as those already enumerated.

The author concludes by stating that he has had personal experience to prove the association of focal sepsis with blepharitis, corneal ulcer, iritis, choroiditis, retinitis, cataract, primary glaucoma and progressive myopia. One may be readily forgiven in proclaiming the writer as overenthusiastic.

A. KNAPP.

THE OCULAR INDICATIONS FOR THE INTERRUPTION OF PREGNANCY AND FOR STERILIZATION. L. HEINE, Arch. f. Augenh. **100-101:** 439, 1929.

The author discusses the following ocular diseases and indications for interruption of pregnancy.

1. Nephrosis: (*a*) albuminuric retinitis, amotioretinae, retinal hemorrhages; (*b*) uremic or eclamptic visual disturbances. One must first determine whether the case is a chronic interstitial nephritis or a nephritis due primarily to pregnancy. The more severe forms of albuminuric retinitis, detachment of the retina or large preretinal or retinal hemorrhages suggest a chronic interstitial nephritis. This is more of an indication for interrupting the pregnancy than a nephritis due primarily to the gravid state.

2. Myopia and glaucoma. It is recognized that any condition which tends to weaken the general health of the patient may increase a preexisting myopia or precipitate attacks of glaucoma. The combination of myopia and glaucoma is especially dangerous during pregnancy.

3. Iridocyclitis and chorioretinitis, especially when due to tuberculosis. The same considerations are true of this group as are true of group 2.

4. General diseases of the nervous system and endocrine disturbances, as multiple sclerosis, cerebral syphilis, pituitary dystrophies, tetany and myotonia, diabetes, axial retrobulbar neuritis and Basedow's disease.

A more general discussion follows of various other ocular conditions, for example, amaurosis after severe hemorrhage, keratoconus and Eales' disease.

Ten cases are reported illustrating the author's conclusions. An abstract of the literature on this subject follows.

F. H. ADLER.

OCULAR OBSERVATIONS IN INFANTS. J. SEISIGER, Arch. f. Augenh. **100-101:** 302, 1929.

A systematic examination was made of the eyes of 500 infants ranging from 1 to 8 days of age. The iris constantly showed a marked development of blood vessels. This appearance was partly due to the

lack of development of pigment cells in the iris stroma, so that the normal circulation was more apparent. In addition to this, however, in about 30 per cent of the cases the iris was covered with a fine superficial network of blood vessels which disappeared in about three weeks following the resorption of the membrana iridis pupillaris. In 95 per cent of the patients, remains of the pupillary membrane could be found, and the author is of the opinion that were it not for the difficulty attending the examination of such young children, these remains could have been found in 100 per cent of the cases. It seems certain that there is a further resorption of the pupillary membrane after birth. The small star-shaped deposits of pigment on the anterior lens capsule were found in only two cases. The larger fibers of the pupillary membrane often contained open vessels and little pigment. In older children, these fibers were often much more pigmented, so it seems that the remains of the pupillary membrane are capable of forming pigment after birth. No cases of true cataract formation were seen. In only 6.6 per cent of the children were there fine opacities.

Since Vogt has found that 25 per cent of normal eyes show so-called anterior axial embryonal cataracts, it would appear that some of these develop after birth. In 19 per cent of the infants, retinal hemorrhages were found varying from small punctate hemorrhages from the finer capillaries to the fully developed picture of thrombosis of the central vein. Most of the cases showing the hemorrhages were in infants, following difficult birth. It is possible that some of the cases of amblyopic eyes may be due to retinal hemorrhages in the macular region, which finally absorb and show no gross changes ophthalmoscopically. An estimation of the refraction was made by skiascopy in all the cases. In no case was myopia found. The average was a hyperopia of 4 diopters.

F. H. ADLER.

Society Transactions

OXFORD OPHTHALMOLOGICAL CONGRESS

H. Dickinson, M.D., *Reporter*

July 4 to 6, 1929

Mr. A. Bernard Cridland, *Presiding*

Diseases of the Lacrimal Apparatus. Prof. Dr. Joseph Meller, Vienna.

The frequency with which stenosis led to epiphora was discussed. Examination of a large number of cadavers showed that the lacrimal canaliculi were normal in only 80 per cent. It could be stated that most lacrimal passages were more or less diseased, but without conjunctivitis. Most of the patients with this disease were women. Roentgen rays afforded the first satisfactory means of seeing the normal or pathologic conditions of the sac in the living person. Often x-rays would give an indication of the kind of operation required. Radium applied to a tuberculous condition of the tear sac gave such successful results, that operation was rendered unnecessary. Many ophthalmologists have made the mistake of regarding epiphora as synonymous with stenosis of the lacrimal duct. Slitting of the canaliculi is now less often performed than formerly; and in all cases the operator must avoid slitting the canaliculus as far as the canthus. For dilation of the tear duct the permanent probe treatment seems to have been abandoned.

Chronic dacryocystitis with more or less copious secretion can occasionally be favorably influenced, even cured, by medical means. Silver nitrate, in 0.25 per cent solution, applied with the syringe, seemed best. Tincture of iodine had been used for the purpose, but it caused considerable irritation of the conjunctiva. After a properly performed extirpation of the sac, the epithora, which before the operation was copious, almost always became so slight that the majority of the patients made no further complaint of it. If, however, a small particle of mucous membrane was left behind, lacrimation continued, and might be as severe as before the operation. It was now recognized that intact canaliculi were not absolutely essential. Notwithstanding slit canaliculi, the epiphora ceased completely after the operation. Kofler's transseptal procedure had increased the view of the field of operation, so that every step of it was carried out under visual control. The operation was performed painlessly under local anesthesia, and the results were excellent, even in elderly people. Professor Meller advised ophthalmic surgeons to extirpate the sac in cases of dacryocystitis in which operative intervention was indicated, because a good extirpation is better than a poor dacryocystorhinostomy.

Intranasal Dacryocystotomy. Dr. J. S. Fraser, Edinburgh.

This contribution was based on ninety-nine cases, in ninety of which the diseased condition was present on one side only. The total number

of operations done in these cases was 108. Most of the patients had already been seen by an ophthalmic surgeon before they came to Dr. Frazer. He was able to keep track of eighty-nine of the patients subsequently, and in sixty-seven of them operation was regarded as completely successful; i. e., there was no recurrence of swelling in the tear sac, no pus could be squeezed out and the eye did not water. The patients said that occasionally when they blew their noses they blew their eyes also. The most successful results were obtained in cases in which there was a definite collection of mucopurulent fluid in the tear sac. Had he tried to get patients to undergo treatment two or three times, doubtless he would have obtained a better figure than 75 per cent of cures.

DISCUSSION

MR. T. HARRISON BUTLER, Birmingham: I have had only four or five cases of troublesome epiphora after operating, and in most of them, on reopening the cavity, I found a relic of mucous membrane. When this was removed, the epiphora ceased. A serious possible complication is ulceration of the cornea from accidental injury during the operation. I have seen two such cases.

MR. E. D. D. DAVIS, London, gave a short review of the subject from the rhinologic point of view, instancing cases in illustration, and demonstrating a series of slides.

DR. S. H. BROWNING, London: I favor the use of ethylhydrocupreine in pneumococcal infections which are common in the lacrimal sac; however, this remedy must be freshly prepared and used with discrimination. Streptothrix infections of the canaliculi are frequently present but are not diagnosed. Patients in whom these infections are present usually deal with horses, and the infection is probably derived from dried horse manure.

MR. D. LEIGHTON DAVIES, Cardiff: I do not regard a patient who has had a West operation done on him as cured unless he is still well three months afterward. Though it could be guaranteed that every patient would go out of the hospital cured a month or so later, contraction of the scar might set in; twenty-four of thirty-eight of my patients since 1912 have been permanently cured. There was a group of patients who did not complain of epiphora afterward, but in whom fluid could not be got through into the nose. These I do not regard as complete cures, and I have not included them as such. Toti's operation is best suited for young people; I have ceased to do it on patients, aged 58 years and over, as they are likely to have hemorrhages.

MR. A. GREENE: Is excision of the lacrimal gland frequently suitable in cases of epiphora without ascertainable cause? I do not think the operation on the nose is satisfactory for a diseased lacrimal sac.

SOME OBSERVATIONS ON THE VASCULARIZATION OF THE VERTEBRATE EYE: DOYNE LECTURE. MISS IDA MANN, D.Sc.

The arrangement of the intra-ocular blood vessels shows many remarkable variations in different species of vertebrates. If the subject is studied from the point of view of comparative embryology, it becomes possible, by the investigation of stages of development common to several

dissimilar species, to arrive at a classification of adult types based on their mode of production. Miss Mann's classification was of the vertebrates. Although in most animals one type of ocular vascularization corresponded with one class of vertebrates, there were many instances of overlapping, as when the lower reptiles showed amphibian characteristics, and of convergence, in which a similar structure was found in two entirely unrelated species, for example, in snakes and in rodents. So far as was known, these exceptions could not be correlated with similarity in other respects, except, possibly, with similarity of visual acuity.

For purposes of discussion Miss Mann divided the ocular vessels into three sets: those of the choroid, those of the retina and those of the iris. In this lecture the choroidal vessels were not considered in detail. She showed that the variations in the retinal and iridic vessels depended, developmentally, on modifications of the proximal and of the distal end, respectively, of the hyaloid artery which was present in all vetebrates at some embryonic stage. Its proximal end might undergo four possible modifications, and these produced the four main types of retinal vascularization: 1. Complete atrophy of the vessel produced an avascular retina nourished entirely by the choroid. 2. Vascularization of the epithelial cells on the optic disk produced a pecten, a structure typical of the birds. 3. Branching of the hyaloid proximally in the vitreous produced a membrana vasculosa retina. 4. Branching of the hyaloid proximally in the retina produced the arteria centralis retinae of the primates.

It could be shown that the presence of a pupillary membrane during development had a marked influence on the definite iris pattern. Those mammals which possessed it showed, in adult life, two types of circulation in the iris: a direct arteriovenous anastomosis in the superficial layers, and a capillary circulation in the deeper parts.

Animals not possessing a pupillary membrane showed only the capillary system, and in them, too, there was a much greater range of iris pattern.

DISCUSSION ON OCULAR MANIFESTATIONS FOUND IN HEAD INJURIES:

MR. HUGH CAIRNS, London: In the past, undue attention has been paid to the fracture of the skull which often follows a blow on the head. Certain of the ocular manifestations of head injury, such as damage to the optic and abducens nerves, are produced by the fracture, but, as a general rule, the important element of a head injury is not the fracture of the skull but the injury to the underlying brain.

The greatest surgical problem is to know which patients will be benefitted by operation. Some patients will inevitably die soon after the injury —such cases are seen in greater numbers with the increase of locomotion. In other cases it is soon evident, after the concussion has passed off, that the injury is comparatively mild, and that with suitable conservative treatment the patient will recover. There remains a third group of cases in which the outcome is for a time uncertain. These are cases in which after recovery from the initial unconsciousness and concussion, there is either a relapse into coma or alternating periods of stupor and lucidity, and those in which concussion does not occur, and unconsciousness only comes on at an interval of hours or days after the accident. In this group the symptoms are usually due to a rise of intracranial

pressure as a result of intracranial hemorrhage, edema of the injured brain or disturbance of the circulation of the cerebrospinal fluid. It is often difficult to decide which are the cases that will be benefitted by operation. In the formulation of a decision the patient's state of unconsciousness is the most useful guide. A blow on the head tends to damage the brain not only at the site of the impact, but also at other places, especially at the opposite side of the brain.

Slight blurring of the disks can be seen in many cases in which at operation a large blood clot, severe cerebral edema or a collection of cerebrospinal fluid in the subdural space is seen. In eighty cases of head injury which I have seen in civil life there were only seven of definite papilledema. When papilledema is present, the patient should have operative treatment, even though at the time he may be relatively free from symptoms. A well planned decompression will give the patient a much better chance of avoiding the chronic ill health which otherwise so often follows head injury. Lateral deviation of the head and eyes toward the injured side is important as indicating the side of the main lesion. Great reliance can also be placed on dilatation and fixity of one pupil as indicating that the major cerebral lesion is on the same side of the body. This sign is particularly valuable when other neurologic evidence seems to indicate that the lesion is on the opposite side. The whole subject of pupillary reactions in head injuries is worthy of close investigation. Mydriatics and morphine should never be used in cases of head injury.

Mr. Cairns also spoke of disturbances of vision in persistent cerebral contusion, after a blow on the head.

MR. CHARLES GOULDEN: From the ophthalmologic aspects of the subject, Bathe Rawling's Hunterian Lectures of 1904 on "Fracture of the Skull" shed valuable light on several problems, and laid down principles of diagnosis whereby the probable course of fracture could be predicted if the site of the blow was known. From 60 to 70 per cent of cases of fracture of the base were shown to be due to direct violence applied to the neighborhood of the base of the skull, whereas from 30 to 40 per cent of basal fractures are due to radiation from fractures of the vault. The path which a fracture of the base may take is largely determined by the various fissures and foramina of the base. Rawling showed that a fracture involving the optic canal may occur in any fracture of the skull, and that such a fracture is more probable when the injury to the head is in the neighborhood of the orbit. In a certain number, the result is partial or total primary optic atrophy, the lesion being unilateral in nearly all cases. After a blow on the head, usually near the orbit—perhaps not sufficiently severe to cause unconsciousness —the eye on the side of the injury is blind. The pupil is dilated and inactive, there is no perception of light, and the ophthalmoscope reveals no pathologic signs. After an interval of from two to six weeks the appearance of primary optic atrophy is found with normal blood vessels. In fracture of the middle fossa there may be injury to the optic chiasma. owing to laceration by a fragment of bone, crushing or compression, and the optic tracts are exposed to some similar injury. Such injuries lead to defects in the visual fields; and cases have been reported of bitemporal hemianopia, due presumably to laceration of the chiasma in its inner part. There may be total blindness in one eye and temporal hemianopia in the other.

Attention is drawn to the value of the pupillary reactions in cases of injury to the optic nerve in fracture of the skull. The other nerves liable to injury in fracture of the base are the oculomotor, the trochlear, the trigeminal, the abducens and the facial. The nerve most commonly involved is the abducens, with consequent paralysis of the external rectus. In that event, however, there is usually an involvement of the other nerves which pass along the cavernous sinus and through the sphenoidal fissure. The fifth nerve is rarely affected in fractures of the base of the skull; the facial nerve is the one most involved in these accidents; Boehm found it to be involved in 22 per cent of cases of fractured base.

CONCLUDING DISCUSSION

MR. JAMESON EVANS: There should be more cooperation between the general and the ophthalmic surgeon in these matters. In two cases of my own unilateral partial blindness was noted after the patient was thrown off a bicycle, the external angular process receiving the force of the impact. Ophthalmoscopic changes were absent for the first few weeks; then there ensued optic atrophy of the nerve on the same side. It was difficult to explain the nature of such a lesion.

MR. T. HARRISON BUTLER: All the cases I have seen of motor bicycle accidents presented either blindness or paralysis of one or other ocular muscles; these conditions were not commonly combined.

MR. N. C. RIDLEY: In a discussion among some ophthalmologists, none of the speakers had seen optic atrophy following simple concussion, although Mr. Lindsay Johnston said he had frequently seen it in the London Zoological Gardens.

MR. COLLYER SUMMERS: A man had primary optic atrophy on the temporal side following an accident. He was seen on several occasions and the field remained constant throughout.

MR. H. M. YRAQUAIR, Edinburgh: In some cases the line of division of the field was horizontal. Complete recovery of vision does not show that the optic nerve has completely recovered, as a peripheral defect of slight degree may remain.

NEW YORK ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY

W. F. C. STEINBUGLER, M.D., *Secretary*

Nov. 18, 1929

ERNEST KRUG, M.D., *Chairman*

A CASE OF TATTOOING OF THE CORNEA WITH PLATINUM CHLORIDE. DR. MARK J. SCHOENBERG.

An Arabian, aged 23, presented himself at the Knapp Memorial Eye Hospital several months before this presentation with an adherent leukoma of the left eye, evidently the result of a severe inflammation

six years previously. The white patch occupied the central area of the cornea; the nasal and upper edges were slightly vascularized. A tattooing with india ink had been attempted some time previously but had proved unsuccessful. About six weeks before presentation the platinum chloride method, as described by Krautbauer of Axenfeld's Clinic, was employed. The underlying factor of this method is the precipitation of metallic platinum from a 2 per cent solution of platinum chloride, by a reducing agent, a 2 per cent solution of hydrazine hydrate. This precipitation takes place on the surface of the parenchyma of the cornea after previous removal of the superficial layers. The spread of the metal is uniform and its thickness is such as to appear perfectly black when looked at with the naked eye. With the corneal microscope, the surface appears dark gray and heavy. A detailed description of the method is contained in Krautbauer's original article.

LACRIMAL GLAND PROLAPSE CORRECTED BY OPERATION. DR. JAMES W. SMITH.

This is the second presentation of a case first shown at the May, 1929, meeting. In the interim, both of the patient's eyes had been operated on and Dr. Smith showed photographs indicating that the glands had been fairly well replaced and that the redundant lid tissue was much less. He called attention to the fact that the last attack of acute rhinitis which the patient had was not complicated by dacry-oadenitis.

DISCUSSION

DR. ARNOLD KNAPP: Dr. Smith, I believe, said that one of the patient's principal complaints was the inflammation of the lacrimal gland which followed an acute coryza. I do not think the fact that the gland is dislocated explains the inflammation in the gland, as I have recently seen a case of dacryo-adenitis developing after an acute tonsillitis and coryza where the gland was in its normal position.

DR. JAMES W. SMITH: In my paper I stated that apart from the cosmetic defect, the patient's chief complaint was that of purulent dacryo-adenitis of the left side complicating each onset of acute rhinitis and coryza. It is interesting to note that on November 1, the patient developed an attack of rhinitis (the only attack since I performed the operation) without the appearance of purulent dacryo-adenitis on the left side. The exposed position of the prolapsed palpebral lobe in the conjunctival fornix probably accounted for the repeated inflammations due to infection ascending from the nose.

MELANOSIS UVEAE AND MELANOMAS OF THE IRIS IN NEUROFIBROMATOSIS. DR. ISADORE GOLDSTEIN AND DR. DAVID WEXLER.

This article appears in full in this issue p. 288.

DISCUSSION

DR. ALGERNON B. REESE: I have had the opportunity to study Dr. Goldstein's and Dr. Wexler's slides in this case. These melanomas appear to me unquestionably to arise from the anterior limiting layer of the iris. This layer, as you well know, is merely a condensation of

the chromatophores of the stroma and is quite thick and pigmented in brunettes, negroes and in persons with melanosis. This is the main reason why medications such as mydriatics, etc., are so slow in affecting the iris in these patients. The endothelium of the iris as the source of these tumors seems to me highly improbable. I have never seen endothelium produce pigment, and there is really no endothelial layer on the anterior surface of the iris. Very exceptionally is endothelium demonstrable on the surface of the iris, and then only in sections prepared with the most careful technic. As far as I know, there is never a real endothelial layer but only occasional endothelial cells here and there. I therefore agree with Dr. Goldstein and Dr. Wexler in regard to the mesodermal origin of these tumors.

Dr. Goldstein and Dr. Wexler use the term melanoma to designate these tumors, and I think, rightly so. In the literature, the terms nevus and melanoma are frequently used interchangeably. They are really two distinct conditions. The nevi appear directly adjacent to epithelium and are composed of polygonal-shaped pigment cells arranged in nests. There is often an angiomatous tendency associated with them. These tumors are seen in the skin and conjunctiva. Melanomas appear in the uveal tract and are composed of branching chromatophores which take on a globular shape when densely packed with pigment. These are seen in the iris, the ciliary body and the choroid. The tumor in this case of Drs. Goldstein and Wexler certainly belongs to the melanoma group.

Normally, fragments of the anterior limiting layer of the iris are reflected around the angle on to the posterior surface of the cornea and thereby cover the internal surface of the pectinate ligament. This is called the ligamentum corneo-iridicum. In cases of melanosis, the anterior limiting layer is very thick, and this ligamentum corneo-iridicum which covers the internal surface of the pectinate ligament is likewise quite thick and also pigmented. Dr. Goldstein's and Dr. Wexler's case shows this beautifully. This may be the explanation of glaucoma which is not uncommonly associated with melanosis in that the filtration of aqueous through the pectinate ligament is interfered with. This pigmentation of the surface of the pectinate ligament is important in gonioscopy, and in this particular case there is a large Schwalbe's ring which is covered with the pigment layer and which might be mistaken with a gonioscope for an early pigment growth.

Sarcoma of the iris characteristically appears in the periphery, and it is interesting to note that the melanomas in this case are located more in the pupillary half of the iris.

DR. BERNARD SAMUELS: I have learned a great deal also from the presentation by Dr. Goldstein and Dr. Wexler and also from Dr. Reese's discussion of their case. To me, it is exceedingly interesting to see the loose cells on the anterior surface, and how sharply demarcated the melanoma of the iris is in this area. These elongated cells must be the endothelium of the anterior surface, the eye having been elevated by the growth.

Another point which interests me in the iris is that these chromatophores have taken the shape of melanomas, whereas in the choroid they appear as melanosis. No doubt the same causes are in the iris as in the choroid, but in the iris they have more space and less resistance to growth, whereas in the choroid, because of the resistance of the struc-

ture, they appear elongated or flattened. I have no doubt, it is the same process in both places. Whether Dr. Reese is right in placing the chromatophores of the anterior surface of the iris just as they occur in the outer layers of the choroid, I do not know.

DR. DAVID WEXLER: It is interesting to note that many years ago, Professor Fuchs pointed out that these melanotic areas appear only in a blue or pale iris. Dr. Reese has remarked that such an iris contains a minimum of pigment. Such pigment deficiency holds also for the anterior limiting membrane. This may be evidence to favor the origin of melanoma from the chromatophores of the stroma.

METABOLISM OF SUGAR IN THE EYE. DR. FRANCIS HEED ADLER, Philadelphia.

Dr. Adler found that the concentration of dextrose in the blood and in the aqueous humor of cats was practically identical. The intra-ocular capillaries which are concerned with the formation of aqueous are freely permeable to sugar, and the metabolism of sugar in the anterior chamber is not sufficient to lower the concentration below that circulating at the same time in the blood stream.

Changes in the concentration of sugar in the circulating blood are reflected almost immediately in the aqueous. There is very little lag under experimental conditions before equilibrium is established.

The concentration of sugar in the vitreous is about half that in the blood. Changes in the blood sugar level eventually cause similar changes in the vitreous sugar level, so that the normal ratio between the two is kept fairly constant, but rapid changes in the blood sugar level are not reflected immediately in the vitreous. A considerable lag occurs in the vitreous sugar level, so that it is possible to have a high concentration of blood and aqueous sugar, with a low concentration of vitreous sugar, and vice versa. This may be a factor in causing the sudden transitory changes of refraction seen in the eye of the patient with diabetes.

Like all other tissues in the body, the ocular tissues have the power of breaking down sugar anaerobically into lactic acid. The retina, however, utilizes about double the amount of sugar used by any other tissue in the eye.

This extremely rapid utilization of sugar by the retina may explain the low concentration of sugar in the vitreous. The passage of material into the vitreous from the blood vessels takes place either on the surface of the retina, i. e., from the retinal blood vessels, or through the whole thickness of the retina, i. e., from the choriocapillaris. It is possible, therefore, that the retina metabolizes a large part of the sugar as it passes out of the blood vessels, leaving a low concentration of sugar to find its way by diffusion through the structure of the vitreous.

This assumes a normal permeability of the retinal and choroidal blood vessels to sugar. There is no evidence of this to the contrary, and it would be a most unlikely phenomenon. Further, it has been shown that large changes in blood sugar do eventually raise the concentration in the vitreous, which means that the vessels are permeable to sugar. A second assumption that this hypothesis necessitates is that the vitreous itself is permeable to the diffusion of sugar. This is proved by the increase in vitreous sugar when the blood sugar level is raised experimentally, even though a considerable lag does occur.

Evidence was presented which suggests that under the influence of light the retina metabolizes sugar more rapidly than in the dark. This evidence is far from conclusive. The breaking down of sugar into lactic acid may be influenced by small changes in the p_H of the solution, and under the influence of light the bleaching of rhodopsin in the retina may change the hydrogen ion concentration of the tissue. Further experiments are under way to show if possible whether this effect of light on sugar metabolism is a real physiologic effect, or is merely due to some unknown chemical factor, the result of the method of experimentation.

DISCUSSION

DR. ARTHUR M. YUDKIN: This splendid investigation on sugar metabolism in the ocular tissue which Dr. Adler presented, deserves considerable commendation. The new angle of sugar metabolism is a very impressive one. He has produced some experimental evidence which may lead to a better understanding of the changes which take place in the refractive indices of the ocular media in diabetes. The results which he obtained corroborate, in part, my work on the constituents of the aqueous humor in the dog. It was a pleasure to listen to this instructive paper.

DR. MARTIN COHEN: I should like to ask Dr. Adler whether he is dealing with combined or free sugar. Other questions are: Does not diastatic activity occur in some of the tissues that were studied; is there not some enzyme action present; cannot one control it by previous bacteriologic examination and could fermentative action be responsible for some of the sugar figures?

DR. BERNARD SAMUELS: I think Dr. Adler has brought out very plainly why it is in diabetic cases that the vitreous is so well preserved. We know the changes that occur in the iris, especially pigmentation of epithelium, and those in the vessels of the retina in diabetes, but I cannot remember any changes in diabetes in the vitreous, which we find particularly opaque. Nearly all the cases of diabetes I recall preserved to a remarkable degree the clearness of the vitreous. What Dr. Adler has explained may be the cause of that preservation.

DR. FRANCIS HEED ADLER: I have had no experience with the Shaeffer-Hartman method. We gave up the Folin-Wu method because of the many discrepancies which occurred in control experiments, but the Hagedorn-Jensen method has been very satisfactory.

Concerning the question of enzyme activity, we had this in mind when we did the experiment of grinding up the retina with sand and of using a protoplasmic poison such as sodium fluoride. The results led us to believe that we were dealing with enzyme activity. At least these experiments showed to us that the metabolism of sugar is not dependent on the integrity of the structure of the retina, but that the retina probably does contain a higher titer of enzyme than any other tissue, which is responsible for its marked utilization of sugar.

Dr. Samuels' remark about the vitreous leads me to ask whether it is a matter of common experience to find the vitreous fluid in cases in which operation was performed for diabetic cataract.

SOME PRACTICAL POINTS IN TONOMETRY. DR. MARTIN COHEN.

This will appear in full in a later issue of the ARCHIVES.

DISCUSSION

DR. JAMES W. SMITH: I think that the chief value of the Schiötz tonometer is in cases with normal intra-ocular pressure or those in which the eyes show increased tension. As Professor Schiötz stated in his original communication, the excursion range of the indicating needle should be limited between the third and sixth millimeter marking on the scale. In this way, assuming that the examiner begins his readings with the 5.5 Gm. weight and the deflection is less than 3 mm., the next highest weight, 7.5 or 10 Gm., can be utilized until the exact increase in intra-ocular pressure is obtained. In the cases with subnormal intra-ocular pressure, the instrument is of considerably less value, depending on how much below normal the pressure is. For example, a deflection of the indicating needle to the sixth millimeter mark (with the 5.5 mg. weight) would represent 15 mm. of mercury. I should like to ask Dr. Cohen if he considers the Schiötz tonometer accurate in recording tension in cases of persistent hypotony and also whether he considers any excursion reading greater than 6 mm. to be accurate enough for record. Would it not be better to refer to all cases in which the readings indicate a pressure less than the minimal normal, as cases of subnormal tension, rather than attempt to express in millimeters of mercury the degree of hypotony?

DR. MARTIN COHEN: As I stated in the paper, I think these lower readings are very unsatisfactory. It is very difficult to record the tension in soft eyes; they are not of practical value.

DR. MANUEL URIBE TRONCOSO: The paper read by Dr. Cohen is very interesting because it summarizes all we know in regard to the different tonometers. I want to emphasize one point, and that is the importance of keeping the eyes of the patient in one position, with the apex of the cornea exactly in the vertical direction. I think I was the first to use the method in which the patient is instructed to look at the point of his own finger, which helps him, by his muscular sense, to maintain a steady position of the eye.

In cases of glaucoma some observers have been using the method of recording tension three times a day. This is very interesting, and permits one to make a chart similar to a temperature chart, but the patient must be kept in the hospital since it is almost impossible for a patient to have these measurements taken at home. Besides, these tonometric examinations should always be made by the same person; otherwise they have much less value.

In cases of hypotony and keratoconus, the readings of the tonometer are very inaccurate, and it would be advisable to have a special plate made to fit the conical cornea and to enlarge the lower scale for hypotony.

DR. JACQUES LANDESBERG: There is one point that I think is worth mentioning. A short time ago at our clinic, eight men took the tension of the same eye of a patient and much to our surprise, no two readings were alike. There was a difference of between 2 and 6 mm. in each man's reading, and going into it a little more carefully, it seems that many factors besides the instrument and the direction of the gaze of the patient are to be considered in taking the tension of the eye. Namely, how the lids are held, how the tonometer is placed on the cornea, etc., all of which seem to affect the final results. I should like to ask

Dr. Cohen whether the taking of the tension is so difficult that two men cannot obtain the same reading with the same tonometer, on the same eye, or whether the personal factor enters into the procedure to such an extent that this is impossible.

DR. ARNOLD KNAPP: There is still one other tonometer, and that is the Schiötz X tonometer. This tonometer is the one on which Professor Schiötz was working at the time of his death. The main point of difference between this instrument and the others is that it has no weights, and, secondly, the bottom of the plunger, instead of being concave, is convex. In a more or less limited use of the instrument, it seemed to me it was easier to apply; one did not always have to have the same position of the eye. The readings were somewhat higher than the old instrument, but probably correspond to the later Schiötz model of which Dr. Cohen spoke.

DR. WILLIAM MCLEAN: The answer to the question relative to the use of the tonometer in hypotony is that tonometer readings in hypotony are unsatisfactory. I have found this so in my work on the living human eye and in my experiments in which I connect the interior of the eye to a manometer.

In regard to the pressure of the eye, the readings indicated by the various tonometers, and the standardization, the first reports I published along this line were in the year 1914. The difference between the readings of intro-ocular pressure as indicated by the Schiötz and by my tonometer lies in the interpretation of our experiments. Aside from the work in which I connect the eye directly to the manometer, I have made more delicate experimentation with the living human eye in situ. In these experiments I interposed a control between the eye under examination and the manometer, using a glass capillary tube 30 inches long which held a tiny bubble midway in the solution. Tonometer readings were made with the control apparatus in position and the connecting valve closed. The manometer pressure was placed at the figure indicated by the tonometer reading. Then the valve was opened and if there was a difference of pressure between the eye and the manometer the bubble would surge toward the lower pressure by the effort of the eye and the manometer to establish equilibrium. Where a change occurred, the pressure of the manometer required to bring the bubble back to its original position was the true pressure of that eye at the time the tonometer reading was made.

I have been particularly fortunate in being allowed to make such an extremely delicate verification of tonometer readings on five living human beings, the results of which were published in a paper I read before this section in 1919. I was again favored in being allowed to make another, the sixth, similar experiment on a living human eye in situ last January. By these experiments I am able to state that my tonometer checks up, under examination, quite closely with the true pressure within those eyes.

I understand Dr. Schiötz has never made a similar experiment on the living human eye. His experiments have all been on dead eyes.

Another significant point is that the limits of normal, as established by my tonometer, are in keeping with all experiments by others in which the living human eye in situ was used, while the upper limit of normal

as indicated by Schiötz' first tonometer is below all the figures of experimenters in which living human eyes in situ were used. Of course, when Schiötz acknowledged that the readings of his tonometer were too low and raised his upper limit of normal about 5 mm., as he has done with his new tonometer, he became more in harmony with other experimenters, although his readings are still too low. I believe had he used experiments on the living human eye in situ, as I did, he would have placed his upper limit nearer to that established by my tonometer.

DR. OLGA SIPCHEVSKA: What is the advantage of the Bailliart tonometer?

DR. MARTIN COHEN: In regard to Dr. Troncoso's question, I wish to state that it is practically impossible to manufacture such a type of instrument for clinical study.

In regard to Dr. Knapp's remarks with reference to the recent X tonometer of Schiotz, I have not seen any publication with respect to it. Dr. Knapp, since the preparation of the paper, has shown me the instrument which I shall procure and study. It appears to be similar to his previous model except that he now uses the 5.5 Gm. weight solely until the pressure reaches 60 mm., when he adds an additional weight. A graph accompanies the instrument. Dr. McLean's instrument is also used without extra weights. His plunger is flat, also Bailliart's. The latter is based on a spring action.

As regards the different readings by different men in the same case, I believe the personal method at times does come into play. When we place the tonometer on the eye, we increase the ocular pressure of that eye, and the oftener this is done the more the pressure changes. These instruments cannot give the precise intra-ocular pressure.

In regard to the question about oscillations, it is very difficult for me at times to find at what point the oscillations remain steady. There are several factors, possibly the air currents in the room; or the pulsations of the surrounding vessels which might affect it. These factors are avoided in the mercury tonometer because the mercury is encased in a capillary glass tube.

COLLEGE OF PHYSICIANS OF PHILADELPHIA, SECTION ON OPHTHALMOLOGY

A. G. FEWELL, M.D., *Clerk*

Nov. 21, 1929

C. E. G. SHANNON, M.D., *Chairman*

GLIOMA OF THE RETINA. DR. CHANCE.

Dr. Chance brought before the section a boy, aged 10, who had come to the hospital only a few days before because his parents had noticed that during the past few weeks a whitish reflex appeared behind the pupil of his left eye. Dr. Chance had not had the opportunity of examining him thoroughly, but as he had been admitted to the ward, hoped to do so.

Deep in the nasal half of the fundus there was a mass which looked like beef-suet, and had on it a few vessels. It projected outwardly somewhat like a glioma mass. In the temporal half of the fundus, two or three other areas could be seen. They appeared as though they had punctured through the retina and choroid. There was no history of injury or of inflammation.

The reason for bringing the boy before the section was for assistance in diagnosis. Dr. Chance had regarded the condition as massive exudation. If it was a case of glioma he had never seen one like it, although he had been consulted in fifty-six cases of glioma. The patient was older than any one he had seen exhibiting early symptoms of glioma. The eye had shown no signs of inflammation or of congestion. The tension had not been elevated by finger touch, and the anterior chamber was of normal depth. The tension at the time of exhibition was a little higher, probably because of pupil expansion and other manipulations of the eye; it had not been present previous to the meeting.

Dr. Chance hopes to be able later to show some slides to explain the strange appearance.

DISCUSSION

DR. SHUMWAY: The sooner the eye is out, the better. The vitreous is comparatively clear, the mass itself is smooth, and somewhat vascular and these scattered masses on the retina are exceedingly suggestive of what we get in microscopic examinations of glioma of the retina. In a great many of the cases which I have examined microscopically in the early stages when the eyeballs are not entirely filled by the tumor mass, you will find on the surface of the retina, collections of tumor cells which are metastatic growths or additional growths. The present case shows this condition, and I would be strongly inclined to make glioma of the retina the diagnosis.

KRUKENBERG'S SPINDLE. DR. J. M. GRISCOM and DR. I. S. TASSMAN.

A negro woman, aged 36, married and the mother of two children, complained of aching of the eyeballs, a condition which had existed for about one year. The family history and past medical history were unimportant. Vision was: right eye, 4/40; left eye, 1/40; with glasses, right eye, 5/40; left eye, 5/40 (Cowan's test card). The patient revealed a high degree of myopia.

External examination with undilated pupils showed the right pupil to be about 4 mm. and the left about 2 mm.; there was no reaction to light. The convergence was poor. With oblique illumination in each eye there could be seen a linear brownish streak extending down the center of the cornea, vertically from just above the middle to within 1 mm. from the lower limbus at 6 o'clock. The streaks appeared to be symmetrical. With the pupils dilated under homatropine they appeared in the same position, brown and somewhat fusiform when examined with the ophthalmoscope. They appeared to be in the posterior layers of the cornea and to be composed of a large number of closely placed individual dots. No remnants of pupillary membrane could be seen. In the right eye there were star-shaped striations in the center of the lens posteriorly. In both eyes, there were numerous floating, filamentous opacities in the vitreous. Both eyes also showed an old extensive

chorioretinitis, and the nerve-heads were pale in color. The perivascular sheaths of many of the vessels were also prominent.

The Wassermann and Meinicke reactions were strongly positive. The teeth were in very poor condition, and examination of the sinuses revealed a marked reaction of inflammation in both ethmoid regions.

Examination with the slit-lamp in the right eye showed the anterior portion of the cornea to be clear. Over the entire posterior surface of the cornea were scattered fine, brown granules, densely arranged in the center to form a vertically oval configuration, extending from just above the lower limbus to about half way between the center and the limbus above. The dots were more and more scarcely distributed toward the periphery. Most of them appeared to lie in front of the endothelial cells, although some might be behind. The iris was markedly atrophied and the anterior surface of the lens contained some fine, brown pigment granules, resembling those deposited on the cornea. At the posterior surface of the lens could be seen a translucent, white membranous deposit arranged in the form of radiating spokes with the center at the pole. This was absent in the left eye; otherwise the examination revealed the same condition as in the right eye.

DISCUSSION

DR. PETER: I reported a case of this kind before this section in 1927. That patient was unusual in that she was 54 years of age and showed hyperopia, with low grade chorioretinal disease of long standing.

The evidence as to the etiology in these cases is in favor of an acquired condition. The age of the patients, the fact that it usually appears in people with myopia and in elderly people, is against the congenital origin of the condition.

The distribution of the spindles is difficult to explain; first, in that they are bilateral; second, in that they occupy a vertical position directly in the center of the cornea; and third, in that the spindles, as a rule, tend to approach more nearly to the lower limbus than the upper.

In the case which I reported, the center of the spindle was rather dense, and the peripheral borders were frayed and branched in appearance, made up of more or less stellate spots, just as though washed and thinned out by the aqueous current. It is not unlikely that the aqueous current is responsible for the peculiar distribution of these deposits, because they occur in what seems to be the most active part of the current.

It is probable, if these cases were carefully studied, a low grade chronic inflammation of long-standing, such as is often observed in myopia, would be found to be present in each and every case. In the case which I reported, the deposits were located on the posterior surface of Descemet's membrane.

DR. HOLLOWAY: About nineteen years ago I reported three histories of such cases, and at that time tabulated the case histories then on record, which comprised some nine or ten reports. Nearly all instances of this pigmentation have occurred in persons affected with myopia, and when astigmatism has been present it has generally been oblique. Since reporting these cases, I have seen at least three and probably four others. One of these was first seen in 1916, again in 1917, 1918 and 1919, and

my notes fail to mention any signs of pigmentation. All of my patients are examined by oblique illumination as well as with the ophthalmoscope, and one is not apt to overlook ocular conditions he has once recorded, so it is difficult to believe it could have been overlooked. The patient was seen again in 1926, when a definite spindle was noted in the right cornea and my notes briefly state "with slit-lamp fine punctate pigment dots, slightly variable in size, on and anterior to Descemet's membrane."

In view of recent developments, I suggested to one of my friends about two weeks ago, that it might be well to bring in the patients I have seen and subject them to accurate slit-lamp examinations. In regard to the etiology, until recently I had always been under the impression that the condition was congenital. This brings up the old question as to whether certain of the so-called congenital conditions are truly inflammatory or are developmental abnormalities. I do not agree with Dr. Peter that if we examine all of these cases we will find evidence of intra-ocular inflammation, because it was not true in certain of my cases, nor in certain other of the recorded histories. The only way this could be accepted would be to assume all cases of myopia as of inflammatory origin and that the myopia was primary in each instance.

In view of the instance cited in the preceding paragraphs and certain other cases now on record, I am beginning to lean toward the belief that there is a possibility of this pigmentation being an acquired manifestation, at least in certain instances.

DR. GRISCOM: This case was presented as a clinical report, and the literature on the subject was not considered because an exhaustive review of the subject was in process of preparation by Dr. Edgerton, of the second year class of the Graduate School of the University of Pennsylvania. This will probably be presented for publication within a reasonable time.

It is difficult to conclude that these cases are congenital because very few show any other sign of inherited ocular defects. It seems rather strange, too, that Krukenberg spindles should be found in adults and not discovered earlier in life, if they are congenital. I feel that they are more likely to be acquired and perhaps have some association with progressive myopia.

VITREOUS HERNIA FOLLOWING TRAUMA. DR. LUTHER C. PETER.

A downward rupture of the left cornea near the limbus resulted in iris incarceration, slight traumatic cataract and some dislocation of the lens with prolapse of the vitreous through the ruptured zonular fibers.

The case was presented because of this series of phenomena, and especially because the vitreous hernia was demonstrable by means of the hand slit-lamp. Although this rather simplified instrument of precision is not as refined as the large slit-lamp, it is most practical in uncovering and analyzing many details in the anterior segment of the eye.

The visual results in the case were good, but the iris incarceration, the dislocation of the lens and the vitreous hernia may bring about definite pathologic changes in the future. Instead of replacing the apparently uninjured iris, excision was the better mode of procedure. As the iris returned so readily with a round pupil, the inclination to risk replacing the iris was strong. It is better surgical procedure, however,

to excise the protruding iris. There is less danger of infection and less likelihood of anterior synechia.

From the standpoint of compensation, it is best to write into the report of such a case, the possibilities of further complications because of the anterior synechia, lenticular dislocation and vitreous prolapse. It is only fair to the patient.

A final point which this case stresses is the necessity for careful study of our cases by instruments which are more refined than those of the ophthalmoscope and oblique illumination. The loupe is useful, but does not possess the wide applicability and differentiation of the slit-lamp, even in this most simplified form.

EXTENSIVE CELLULITIS OF LIDS AND SCALP IN A CHILD. DR. G. E. DE SCHWEINITZ AND DR. A. G. FEWELL.

Severe cellulitis of the lids complicating chickenpox appeared in a child, aged 8. The diagnosis of chickenpox was made on May 24, 1929. The cellulitis of the left lids was first noticed three days later. The infection of the lids had evidently started from a small pock from which pus was expressed, on the side of the nose near the inner canthus. The temperature jumped from 100 to 105 F. in a short time. When first seen, the lids were completely closed, brawny, and of a putty color. Both lids were incised, a small amount of pus being obtained from the upper lid but none from the lower. A culture taken at the time was reported as pure *Streptococcus hemolyticus*. On the following day, considerable pus was obtained from each lid. Small rubber drainage tubes were placed in each lid, and in spite of seemingly free drainage, the patient continued to run a typical septic temperature and seemed very ill. The cornea was not affected, and there was no proptosis of the globe at any time. A blood culture taken at this time was negative.

On June 7, there was some swelling extending from the outer canthus to the ear, evidently a pocket of pus forming beneath the skin of the upper part of the face. An incision was made just above and in front of the left ear on June 11, and through and through drainage established. The temperature gradually dropped to normal within a few days, and convalescence was rapid. The lids healed rapidly, and there is now little evidence of scarring.

INSTANTANEOUS COLOR PHOTOGRAPHY OF THE HUMAN EYE. DR. LAURANCE D. REDWAY (New York).

There are few people who do active clinical work in ophthalmology, and especially those concerned with undergraduate or postgraduate teaching, who will not appreciate the extraordinary advantages to be gained by the application of instantaneous color photography to this work. In the past, to say "color photography" was to conjure up a vision of infinite complexities, in which as in a murky haze, dark phantoms with hands indelibly stained with outlandish chemicals and special cameras of weird design, were seen under a pall of comparative secrecy. Until recently, this conception of color photography was not altogether unwarranted. One dealt with color photography as a hobby, or as a solace in advancing years. Certainly, it had no place in the practical life of the day. And reasonably so, because at that time its

methods were so uncertain, its results so horrendous, that only an enthusiast would tolerate them. A flair for color photography at that time was considered almost as a mild dementia. But improvements in methods and materials of later years have advanced the art far beyond earlier expectations. In fact, it is fair to say that to take and to finish a color plate such as those to be shown here, is now possible in the space of fifteen minutes, a feat not practical even with the ordinary black and white snapshot taken with a kodak. Simplicity, then, has superseded the old clumsy methods, and has reduced color photography almost to the status of a mathematical equation, solvable by any one with a common high school education.

It is true that outdoor color photography, dependent on varying intensities and qualities of daylight, still requires considerable training and practice to produce proper results. In instantaneous color photography of eyes, however, it is now possible to work under carefully calculated and controlled conditions of illumination and exposure, assuring under such control, almost perfect results.

Granted the simplicity of operation and reliability as to results, what are the advantages to be gained? If you will consider the inadequacy of the present black and white halftone illustrations in textbooks to convey in most instances an exact idea of what they are supposed to represent, the question is half answered. Except where stereoscopy is resorted to with its necessary accompaniment of cumbersome paraphernalia, black and white illustrations lack contour; they are lifeless and dead. The same is true of projected transparencies of this order. To obtain good color illustrations either for textbook or classroom work, the services of a good artist are required. And to obtain a good one, at the time when he is needed, is often not a simple matter.

Consider the matter of clinical records. The clinician desires to demonstrate a case of acute herpes of the cornea, a pigmented sarcoma at the limbus or a hypopyon ulcer. If your experience coincides with ours, there is probably no such case in the city at the time, there seems to be what amounts almost to a conspiracy of sorts in the matter. But with adequate color records available for demonstration, it is not only possible to show what is desired at the time but also what is otherwise impossible under any circumstances: namely, consecutive records of a single case from the time of its inception to its discharge, its behavior under treatment, its reactions to medication and the results of operative work.

These things are instantly available to the instructor. They are available in color, affording what in many instances is the chief diagnostic feature of the case, and are available in contour. The projected color plate by color interference is viewed pseudo-stereoscopically and thus its planar definition is preserved, the illusion of depth being relatively perfect.

Apparatus necessary to the work is simple. Essentially, it consists of a horizontal microscope and a source of light, the relations of these being permanently fixed. A small pilot light affords sufficient illumination for focusing. The patient is seated as he would be for a slit-lamp examination. The eye is exposed to no light save to that of the pilot lamp until the instant of exposure. Even this feeble pilot light can be varied in intensity if desired, so that the state of the pupil can be

controlled at will. The exposure being for approximately one-fiftieth of a second only, the eye is perfectly static, and as the light beam is incident to the pupil at an angle, the greatest intensity does not fall on the macula. There follows scotoma for a short period but there is no further effect on the patient. Since the focusing light is subdued and the exposure so short, even eyes that are very sensitive to light may thus be photographed without difficulty.

The finished transparencies may then be projected. Because they are smaller than the normal lantern slide, a kit must be used to adapt the ordinary projection apparatus to this use, but that is the only change necessary to be made. The small size of the plate is, however, a very practical advantage in the matter of transportation and of storage.

As to permanency of color, many of the plates shown here are over a year old, and have shown no tendency to fade, although they have been repeatedly exposed to the intense light and heat of the projection lamp. Copies of these plates can readily be made, and therefore valuable originals can be stored safely and used merely for the production of subsequent copies.

Heretofore it has not been possible to reproduce such screen plates satisfactorily both as to color and detail by the four color engraving process. But due to the kindness and interest of Mr. Harry Groesbeck and the Walker Engraving Company, of New York, new developments have been made during the last year obviating this difficulty, as you can see by the very excellent reproduction here shown. With the possibility of printed reproductions, the facility with which the plates may be copied, and the simplicity of making them in mind, there seems to be no good reason why color photography should not be widely adopted by ophthalmologists as a teaching adjunct and as a means of improving the general quality of textbook illustration in the ensuing years. I shall not even attempt to touch on its usefulness in medicolegal work or on its possibilities as an aid to research.

Naturally, it is impossible to deal adequately with a subject of this kind in a paper. The plates themselves tell the story and do their own pleading. But I have attempted to introduce them to you by anticipating some of the questions which will naturally arise as a consequence of the consideration of a new subject, probably foreign to most of you, but nevertheless, one in which further developments and improvements may be daily anticipated, as the attention of the medical profession is called to its possibilities.

Book Reviews

THE EYE IN GENERAL MEDICINE. By A. MAITLAND RAMSAY, M.D. Price, $5 net. Pp. 255. New York: William Wood & Company, 1929.

Those who enjoyed and profited by the study of "Diathesis and Ocular Diseases" will be glad to see that the author has written a second edition, much enlarged and rearranged, which now carries the title of "The Eye in General Medicine." While not an exhaustive treatise, it gives the results of personal clinical experience in certain chapters, which have particularly appealed to the author.

The book stresses the constitutional factor in diseases of the eye and begins with disordered carbohydrate metabolism. Inability to deal with starch and sugar not only renders the patient vulnerable to every form of infection, but renders him liable to phlyctenular keratoconjunctivitis, and in adults to tobacco and alcohol amblyopia and diabetic changes in the eye.

Under defective elimination, with renal inadequacy, the author discusses certain diseases of: (1) the optic nerve and retina, (2) the conjunctiva and sclera and (3) the uvea.

The rôle of the capillaries is mentioned in the chapter on acute glaucoma, in which the underlying cause is stagnation of the blood in the overdilated capillaries of the ciliary processes.

Chapter V deals with the double innervation of the ciliary and iris muscles and shows the striking analogy of the nerve supply of the iris to that of the heart. A similarity is also shown in their reaction to drugs. The pain following physostigmine is the same as that produced by spasm of any unstriped muscle anywhere in the body.

The medical aspects of eye strain, pneumococcal infection, toxic inflammation of the iris, with the importance of constitutional tendencies, and ocular manifestations of cardiovascular disease are also taken up.

An important and instructive chapter is devoted to constitutional in addition to local treatment for diseases of the eye. This serves to bridge over the gap between narrow specialism and general medicine and emphasizes the importance of the broad principles that underlie all rational therapeutics.

"The ophthalmologist must be first and foremost a medical man, familiar with general medical problems and principles" is the author's final admonition.

An appendix of prescriptions concludes this valuable volume, which carries an important message to every young ophthalmologist.

A. K.

REPORTS OF THE COMMITTEE ON THE PHYSIOLOGY OF VISION. II. DARK ADAPTATION (REVIEW OF THE LITERATURE). By DOROTHY ADAMS. Medical Research Council Special Bulletin 127. Price, 5 shillings. London: His Majesty's Stationery Office, 1929.

Since Aubert in 1865 made the first systematic study of dark adaptation, it has been the subject of a great many investigations and

especially in recent years has attracted more and more attention. The subject is a broad one, offering many distinct lines of study in which not only the ophthalmologist, but the psychologist and physiologist as well have been interested. This has resulted in a voluminous literature which has appeared in many different types of publications and in several languages. It has thus become increasingly difficult to trace these various references.

For this reason the review of the literature prepared by Dorothy Adams for the Medical Research Council will undoubtedly prove of great benefit to those interested in this subject.

The work is by far the most complete review of the literature on the subject that has appeared, including as it does more than 800 references. Each phase of the subject is taken up in turn, and a digest of the literature is presented from the original articles up to the present. The discussion of individual articles is necessarily brief, the most important receiving the most consideration, and certain ones are recommended to be read in the original.

Miss Adams is to be congratulated on the systematic thoroughness with which she has presented this work.

PAUL A. CHANDLER.

Directory of Ophthalmologic and Otolaryngologic Societies *

FOREIGN

Oxford Ophthalmological Congress

Master: Dr. A. B. Cridland, Salisbury House, Chapel Ash, Wolverhampton, England.
Secretary: Dr. C. G. Russ-Wood, 12 St. John's Hill, Shrewsbury, England.
Place: Oxford. Time: July 10-12, 1930.

Deutschen Ophthalmologischen Gesellschaft

Secretary: Prof. A. Wagenmann.
Place: Heidelberg. Time: June 12-14, 1930.

NATIONAL

American Medical Association, Section on Ophthalmology

Chairman: Dr. T. B. Holloway, 1819 Chestnut St., Philadelphia.
Secretary: Dr. William C. Finnoff, Imperial Bldg., Denver.
Place: Detroit. Time: June 23-27, 1930.

American Academy of Ophthalmology and Oto-Laryngology

President: Dr. William H. Wilder, 122 S. Michigan Ave., Chicago.
President-Elect: Dr. J. F. Barnhill, Miami Beach, Florida.
Executive Secretary: Dr. William P. Wherry, Medical Arts Bldg., Omaha.
Place: Chicago. Time: October, 1930.

American Ophthalmological Society

President: Dr. W. Campbell Posey, Radnor, Pa.
Secretary: Dr. Emory Hill, 501 E. Franklin St., Richmond, Va.
Place: Hot Springs, Va. Time: June 2-4, 1930.

SECTIONAL

New England Ophthalmological Society

President: Dr. S. Judd Beach, 704 Congress St., Portland, Maine.
Secretary-Treasurer: Dr. E. B. Dunphy, 520 Commonwealth Ave., Boston.
Place: Massachusetts Eye and Ear Infirmary, 243 Charles St., Boston. Time: 8 p. m., third Tuesday of each month from November to April, inclusive.

Pacific Coast Oto-Ophthalmological Society

President: Dr. Arthur Jones, 105 N. 8th St., Boise, Idaho.
Secretary-Treasurer: Dr. Walter F. Hoffman, 817 Summit Ave., Seattle.
Place: Victoria, B. C. Time: September 3-5, 1930.

Puget Sound Academy of Ophthalmology and Oto-Laryngology

President: Dr. Will Otto Bell, Medical-Dental Bldg., Seattle.
Secretary-Treasurer: Dr. Francis A. Brugman, Medical-Dental Bldg., Seattle.
Time: 8 p. m., third Tuesday of each month, except July and August.

Southern Medical Association, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Fred Hasty, 119 Seventh Ave., Nashville, Tenn.
Secretary: Dr. Fletcher D. Woodward, Box 162, University, Va.
Place: Louisville, Ky. Time: November, 1930.

* Secretaries of societies are requested to furnish the information necessary to make this list complete and to keep it up to date.

STATE

Colorado Ophthalmological Society

President: A presiding officer is selected for each meeting alternately until all members have served.
Secretary: Dr. Donald H. O'Rourke, 217 Imperial Bldg., Denver.
Place: First floor, Metropolitan Building, Denver. Time: 7:30 p. m., third Saturday of the month, October to April, inclusive.

Eye, Ear, Nose and Throat Club of Georgia

President: Dr. George B. Smith, Rome.
Secretary-Treasurer: Dr. William O. Martin, Jr., 384 Peachtree St., Atlanta.

Indiana Academy of Ophthalmology and Oto-Laryngology

President: Dr. H. A. Van Osdol, 320 N. Meridian St., Indianapolis.
Secretary: Dr. Robert J. Masters, 23 E. Ohio St., Indianapolis.
Place: Indianapolis. Time: December 10 and 11, 1930.

Minnesota Academy of Ophthalmology and Oto-Laryngology

President: Dr. C. N. Spratt, 900 Nicollet Ave., Minneapolis.
Secretary-Treasurer: Dr. J. H. Morse, 80 S. 7th St., Minneapolis.

Montana Academy of Oto-Ophthalmology

President: Dr. Lee W. Smith, 125 W. Granite St., Butte.
Secretary: Dr. J. G. Parsons, Lewistown.

North Dakota Academy of Ophthalmology and Otolaryngology

President: Dr. George M. Constans, Bismarck.
Secretary-Treasurer: Dr. F. L. Wicks, Valley City.

Oregon Academy of Ophthalmology and Oto-Laryngology

President: Dr. J. W. McCollom, 346½ Washington St., Portland.
Secretary-Treasurer: Dr. Andrew J. Browning, 418 Mayer Bldg., Portland.
Place: Good Samaritan Hospital. Time: Third Tuesday of each month.

Rhode Island Ophthalmological and Otological Society

President: Dr. J. E. Raia, 276 Broadway, Providence, R. I.
Secretary: Dr. F. W. Dimmitt, 195 Thayer St., Providence, R. I.
Place: Rhode Island Medical Library. Time: 8:30 p. m., second Thursday in October, December, February and April.

Utah Ophthalmological Society

President: Dr. F. M. McHugh, 17 Exchange Pl., Salt Lake City.
Secretary-Treasurer: Dr. H. Leroy Smith, Ezra Thompson Bldg., Salt Lake City.

Virginia Society of Oto-Laryngology and Ophthalmology

President: Dr. H. B. Stone, 303 1st St., S. W., Roanoke.
Secretary-Treasurer: Dr. Fletcher D. Woodward, Box 162, University.

LOCAL

Academy of Medicine of Northern New Jersey, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Frederick J. Wort, 1080 Broad St., Newark.
Secretary: Dr. Earl LeRoy Wood, 31 Lincoln Park, Newark.
Place: 91 Lincoln Park South. Time: 8:45 p. m., second Monday of each month.

Academy of Medicine of Toronto, Section of Ophthalmology

Chairman: Dr. Louis Joseph Sebert, 86 Bloor St., W., Toronto.
Secretary: Dr. Alexander E. MacDonald, 151 Bloor St., W., Toronto.
Time: First Monday of winter months.

Atlanta Academy of Ophthalmology and Oto-Laryngology

President: Dr. Leon E. Brawner, 157 Forrest Ave., Atlanta, Ga.
Secretary: Dr. William O. Martin, Jr., 384 Peachtree St., Atlanta, Ga.
Place: Academy of Medicine, 38 Prescott St. N. E. Time: 8 p. m., last Thursday of each month.

Baltimore Medical Society, Section on Ophthalmology

Chairman: Dr. Leo J. Goldbach, 1012 N. Charles St., Baltimore.
Secretary: Dr. Angus Lloyd MacLean, Johns Hopkins Hospital, Baltimore.
Place: Medical and Chirurgical Faculty, 1211 Cathedral St. Time: 8:30 p. m., fourth Thursday of each month from October to May.

Brooklyn Ophthalmological Society

President: Dr. Robert M. Rogers, 680 St. John's Pl., Brooklyn.
Secretary: Dr. William F. C. Steinbugler, 515 Ocean Ave., Brooklyn.
Place: Kings County Medical Society Bldg., 1313 Bedford Ave. Time: Third Thursday of February, April, May, October and December.

Buffalo Ophthalmologic Club

President: Dr. E. E. Blaauw, 190 Ashland Ave., Buffalo.
Secretary-Treasurer: Dr. A. F. Luhr, Medical Arts Bldg., Buffalo.

Chicago Ophthalmological Society

President: Dr. Charles G. Darling, 30 N. Michigan Ave., Chicago.
Secretary: Dr. Richard C. Gamble, 30 N. Michigan Ave., Chicago.
Place: Medical and Dental Arts Club. Time: Third Monday from October to May.

Cleveland Academy of Medicine, Section of Ophthalmology and Oto-Laryngology

Chairman: Dr. M. Paul Motto, Rose Bldg., Cleveland.
Secretary: Dr. A. D. Ruedemans, Euclid and E. 93d St., Cleveland.
Place: Winton Hotel. Time: Fourth Friday of each month.

Cleveland Ophthalmological Club

Chairman: Dr. W. E. Bruner, Guardian Bldg., Cleveland.
Secretary: Dr. M. P. Motto, Rose Bldg., Cleveland.

College of Physicians, Philadelphia, Section on Ophthalmology

Chairman: Dr. Maxwell Langdon, 1530 Locust St., Philadelphia.
Clerk: Dr. Alexander G. Fewell, 1924 Pine St., Philadelphia.
Time: Third Thursday of every month from October to April, inclusive.

Dallas Academy of Ophthalmology and Oto-Laryngology

President: Dr. D. L. Bettison, Medical Arts Bldg., Dallas, Texas.
Executive Secretary: Dr. W. Mood Knowles, Medical Arts Bldg., Dallas, Texas.
Recording Secretary: Dr. L. A. Nelson, 4105 Live Oak, Dallas, Texas.
Place: Dallas Athletic Club. Time: 6 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

Detroit Ophthalmological Club

Chairman: Members rotate alphabetically.
Secretary: Dr. Parker Heath, David Whitney Bldg., Detroit.
Time: 6:30 p. m., first Wednesday of each month.

Eastern New York Eye, Ear, Nose and Throat Association

President: Dr. John P. O'Keefe, 251 State St., Albany.
Secretary-Treasurer: Dr. Arthur F. Holding, 142 Washington Ave., Albany.
Time: Third Wednesday of October, November, March, April, May and June.

Fort Worth Eye, Ear, Nose and Throat Society

President: Dr. W. R. Thompson, 510 Main St., Fort Worth, Texas.
Secretary-Treasurer: Dr. R. H. Needham, Fort Worth National Bank Bldg., Fort Worth, Texas.
Place: University Club. Time: 6:30 p. m., first Friday of each month except July and August.

Houston Academy of Medicine, Eye, Ear, Nose and Throat Section

President: Dr. John H. Foster, 1300 Walker Ave., Houston, Texas.
Secretary: Dr. Edward W. Griffey, Houston Clinic, Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., first Thursday of each month from September to June.

Indianapolis Ophthalmological and Oto-Laryngological Society

President: Dr. Robert J. Masters, Hume-Mansur Bldg., Indianapolis.
Secretary: Dr. Kenneth L. Craft, Hume-Mansur Bldg., Indianapolis.
Place: University Club. Time: 6:30 p. m., second Thursday of each month from October to May.

Kansas City Society of Ophthalmology and Otolaryngology

President: Dr. L. R. Forgrave, Logan Bldg., St. Joseph, Mo.
Secretary: Dr. A. E. Eubank, Argyle Bldg., Kansas City, Mo.
Time: Third Thursday of each month from September to May. The November, January and March meetings are devoted to clinical work.

Long Beach Eye, Ear, Nose and Throat Society

President: Dr. W. B. Wright, Jr., 1209 Pine Ave., Long Beach, Calif.
Secretary-Treasurer: Dr. M. A. Schurter, 114 E. 7th St., Long Beach, Calif.
Place: Pacific Coast Club. Time: Last Wednesday of each month from September to June.

Los Angeles County Medical Society, Section on Ophthalmology and Otolaryngology

President: Dr. A. Ray Irvine, 727 W. 7th St., Los Angeles.
Secretary-Treasurer: Dr. J. Frank Friesen, 727 W. 7th St., Los Angeles.
Place: California Lutheran Hospital, Assembly Room. Time: 8 p. m., first Monday of each month.

Medical Society of the District of Columbia, Section of Ophthalmology and Oto-Laryngology

Chairman: Dr. Louis S. Greene, 1710 Rhode Island Ave. N. W., Washington.
Secretary: Dr. E. R. Gookin, Medical Science Bldg., Washington.
Place: 1718 M St. N. W. Time: 8 p. m., third Friday of each month.

Memphis Society of Ophthalmology and Oto-Laryngology

Chairman: Each member, in alphabetical order.
Secretary: Dr. R. O. Rychener, Exchange Bldg., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

Milwaukee Oto-Ophthalmic Society

President: Dr. Edward R. Ryan, 425 E. Water St., Milwaukee.
Secretary-Treasurer: Dr. O. P. Schoofs, 120 E. Wisconsin Ave., Milwaukee.
Place: University Club. Time: 6:30 p. m., third Tuesday of each month.

Nashville Academy of Ophthalmology and Otolaryngology

Chairman: Dr. R. J. Warner, 706 Church St., Nashville, Tenn.
Secretary-Treasurer: Dr. W. W. Wilkerson, Jr., Bennie-Dillon Bldg., Nashville, Tenn.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month.

NEW ORLEANS OPHTHALMOLOGICAL AND OTOLOGICAL SOCIETY

President: Dr. W. A. Wagner, Pere Marquette Bldg., New Orleans.
Secretary-Treasurer: Dr. M. F. Meyer, Canal Bank Bldg., New Orleans.
Place: Eye, Ear, Nose and Throat Hospital. Time: Third Thursday of each month from October to June.

NEW YORK ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY

Chairman: Dr. E. F. Krug, 12 W. 44th St., New York.
Secretary: Dr. William F. C. Steinbugler, 815 Park Ave., New York.
Time: 8:30 p. m., third Monday of every month from October to May, inclusive.

OMAHA AND COUNCIL BLUFFS OPHTHALMOLOGICAL AND OTOLARYNGOLOGICAL SOCIETY

President: Dr. Charles M. Swab, Medical Arts Bldg., Omaha.
Secretary-Treasurer: Dr. J. C. Davis, 1615 Howard St., Omaha.
Place: Medical Tea Room. Time: 5:15 and 7:00 p. m., third Wednesday of each month from October to May.

PITTSBURGH OPHTHALMOLOGICAL SOCIETY

President: Dr. Edward B. Heckel, Jenkins Arcade Bldg., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: Pittsburgh Academy of Medicine Bldg. Time: Fourth Monday of each month, except June, July, August and September.

PITTSBURGH SLIT-LAMP SOCIETY

President: Dr. W. W. Blair, 121 University Pl., Pittsburgh.
Secretary: Dr. George H. Shuman, Park Bldg., Pittsburgh.
Place: 121 University Pl. Time: Second Monday evening of every month, except June, July, August and September.

ROCHESTER EYE, EAR, NOSE AND THROAT SOCIETY

Chairman: Dr. A. Vincent Walker, 833 South Ave., Rochester, N. Y.
Secretary-Treasurer: Dr. John F. Gipner, 53 Fitzhugh St., Rochester, N. Y.
Place: Rochester Medical Assn., 113 Prince St. Time: 8 p. m., third Monday of each month from October to May.

ST. LOUIS OPHTHALMIC SOCIETY

President: Dr. Charles W. Tooker, 308 N. 6th St., St. Louis.
Secretary: Dr. Carl T. Eber, 1006 Carleton Bldg., St. Louis.
Place: St. Louis or Washington University Cafeteria.
Time: 6:30 p. m., fourth Friday of each month from October to April, inclusive.

SAN ANTONIO OPHTHALMOLO-OTO-LARYNGOLOGICAL SOCIETY

President: Dr. F. W. Sorrell, Gibbs Bldg., San Antonio, Texas.
Secretary-Treasurer: Dr. A. F. Clark, 728 Main Avenue, San Antonio, Texas.
Place: Bexar County Medical Library. Time: 8 p. m., first Tuesday of each month from October to May.

SPOKANE ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. A. N. Codd, 421 W. Riverside Ave., Spokane, Wash.
Secretary: Dr. Marc Anthony, Old National Bank Bldg., Spokane, Wash.

SYRACUSE EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. George H. Rockwell, Physicians Bldg., Syracuse, N. Y.
Secretary-Treasurer: Dr. A. Harry Rubenstein, Medical Arts Bldg., Syracuse, N. Y.
Place: University Club. Time: Second Friday of each month except June, July and August.